ILLUMINATING ENGINEERING

AUGUST 1951

Why We Analyze the Industrial Lighting Problem
Reflectances of Printing Inks and Paper
Good Capacitors for Quality Ballasts
Guide for Outdoor Illumination Tests
Judging Furs by Artificial Light
Luminous Ceilings for Offices
Research Gives the Answers

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

Everyone concerned with specifying or providing ideal luminous-acoustical environments . . . should read this book
Wakefield CEILING

There never was a book like this because there never was a product like this. The Wakefield Ceiling is a completely integrated means of providing total luminous-acoustical environments, produced in accordance with your specifications at the Wakefield factory, shipped complete to the job and installed in its entirety by a Wakefield-licensed electrical contractor. To know about the Wakefield Ceiling you must read this book. A letter on your business stationery will bring you a copy, free of charge. Write to *The F. W. Wakefield Brass Company, Vermilion, Ohio.*

Wakefield Over-ALL Lighting

"Cuts cost three ways"

with Westinghouse MERCURY lighting

A tank company in Illinois ran cost studies on the new Westinghouse Mercury Lighting System. Results:

1. Operating costs are reduced because mercury vapor produces more light per dollar than any other light source.
2. Maintenance costs are cut because it takes fewer fixtures to produce high levels of illumination than with any other lighting system.
3. Lamp replacement costs are lower, because mercury vapor lamp life is 5,000 hours—5 times longer than the most efficient incandescent lamp.

This is one of hundreds of "time-tested" installations. Investigate the Westinghouse Mercury Vapor Line: 400, 1000 and 3000-watt units for low or high-bay areas . . . open or closed fixtures for clean or dirty locations . . . low or high-voltage ballasts for any distribution system.

Send for B-4727, **"Westinghouse Lighting at Work" in every industrial area.** Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

YOU CAN BE SURE.. IF IT'S

Westinghouse

LIGHTING DIVISION

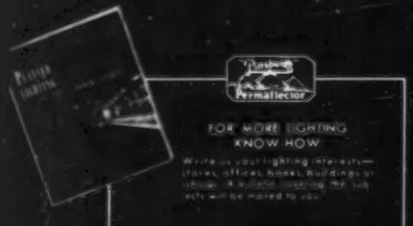
Edgewater Park, Cleveland

J-04295

a LIGHT job* *well done*

WITH PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT

OUTSTANDING! This one word completely describes the illuminating results so easily and successfully achieved at famous Wurzburg, the heart of Grand Rapids. Pittsburgh Permaflector Equipment enabled Wurzburg to plan with imagination and light for their needs. Top performance with "custom designed" appearance was assured. Fluorescent and incandescent units, and combinations of both, meet every lighting requirement.



PITTSBURGH REFLECTOR COMPANY

411 OLIVER BUILDING • PITTSBURGH 22, PENNSYLVANIA

MANUFACTURER OF FLUORESCENT & INCANDESCENT LIGHTING EQUIPMENT

Permaflector Lighting Engineers in All Principal Cities

PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT IS DISTRIBUTED BY BETTER ELECTRICAL WHOLESALERS EVERYWHERE

ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

AUGUST
1951

Vol. XLVI
No. 8

Research Gives the Answers 383
Judging Furs by Artificial Light ..... Floyd W. Sell 389
Correlated Lighting and Design in Wurzburg Department Store ..... John S. Frizzell 392
Lighting Data Sheet — Series XVI
Lighting an Apartment Living Room (22-29) 395
Lighting for the Audience ..... Stanley McCandless 397
Why We Should Analyze the Industrial Lighting Problem ..... L. Court Butler 403
Lighting Data Sheet — Series XVI
Lighting a Store (12-82) 405
Good Capacitors—A "Must" in Quality Ballasts ..... R. F. Rowe and L. E. Gregory 406
Luminous Ceilings for Offices ..... Russell C. Putnam 410
Specular and Diffuse Reflectances of Printing Ink and Common Papers
H. M. Sharp and J. F. Parsons 413
Lighting Requirements for a New Color Film for Professional Motion Pictures ..... Richard Blount 415
Lighting Data Sheet — Series XVI
Lighting an Underpass (26-22) 417
Night Skiing on Floodlighted Slopes ..... D. R. Brown 418
Floodlighting a Quarter-Mile Auto Race Track ..... R. H. Goodman 420
Modern Approach to Lighting Gasoline Service Stations ..... Howard Ketcham 422
I.E.S. Guide for Outdoor Illumination Tests 425
TELECAST—Lighting News of Current Interest 5A
Lighting Calendar, 7A; Installations to See in Chicago, 9A; New Members, 11A
Miscellaneous Short Items—
Servicing Pits for Diesel Inspection, Milwaukee, 392; New Mercury Installation Boosts Illumination Levels, Colorado Springs, Colo., 404; Ingenious Device Simplifies Maintenance, Vermilion, Ohio, 416
Sustaining Members 14A
I.E.S. Publications ..... 25A and 26A
New Equipment Data 28A
Index to Advertisers 31A

1950-51 Officers

Walter Sturrock, President
S. G. Hibben, Vice-President
E. M. Strong, Vice-President
A. H. Manwaring, Gen. Sec'y
R. F. Hartenstein, Treasurer

Staff

Ruby Redford
Editor

Clayton E. Ellis
Advertising Manager

Publications Committee

E. C. Huerkamp, Chairman
E. H. Church
H. H. Magdsick
R. W. McKinley
Richard G. Slauer
J. M. Stedman

STATEMENTS and opinions in articles and papers in ILLUMINATING ENGINEERING are the expressions of contributors and do not necessarily represent the policies or opinions of the Society. Official Society opinions are expressed only in official committee reports specifically approved by the Council of the Illuminating Engineering Society.

Founded 1906

ILLUMINATING ENGINEERING SOCIETY

A. D. Hinckley
Executive Secretary

C. L. Crouch
Technical Director

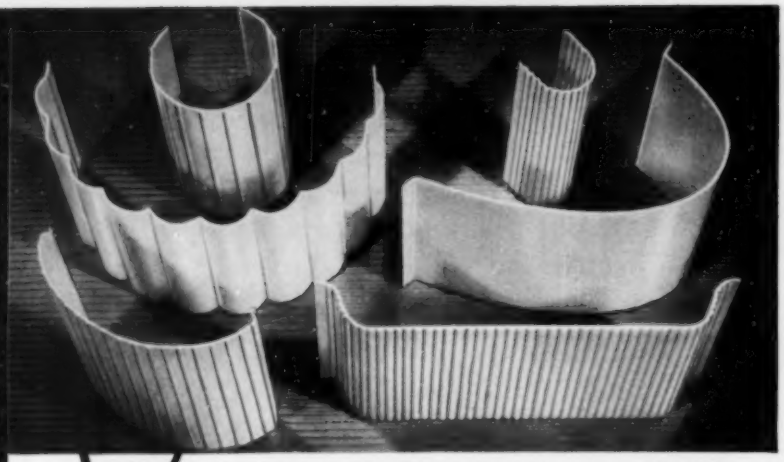
PUBLICATION office 32d Street & Elm Avenue, Baltimore, Md.

EDITORIAL and advertising offices 1860 Broadway, New York 23, N. Y.

ILLUMINATING ENGINEERING: The Journal of the Illuminating Engineering Society. Copyright 1951 by the Illuminating Engineering Society. Published monthly in the United States of America. Entered as second-class matter at the Post Office, Baltimore, Md. Acceptance for mailing at special postage rates provided for in Section 1103 P.L.&R., Act of October 3, 1917. Authorized July 16, 1918. ¶ Subscription $10 per year plus extra postage to all countries to which second-class postage rates do not apply; single copies $1.50. ¶ Address changes must be received at I.E.S. headquarters by the first of the month to be effective with the issue of the next succeeding month.

"POLY-LITE"®

SIDE AND BOTTOM PANELS FOR FLUORESCENT LIGHTING FIXTURES

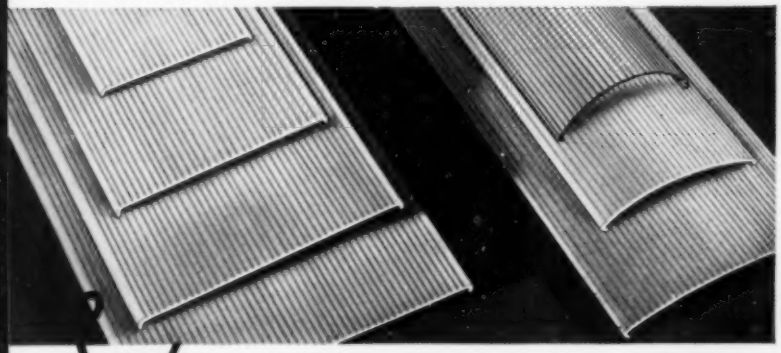


Sandee CUSTOM-MADE FLUORESCENT PANELS

Custom Panels produced to your most exacting specifications with nominal tooling costs. Design, engineering and laboratory facilities at your disposal.

SAVE SAFELY WITH SANDEE PANELS

UNIFORM FULL THICKNESS . . elimination of dangerous overhead weight . . breakage reduction of 80% to 90% . . lower shipping costs (about ⅛ the weight of glass) . . quality that gives long term satisfaction.



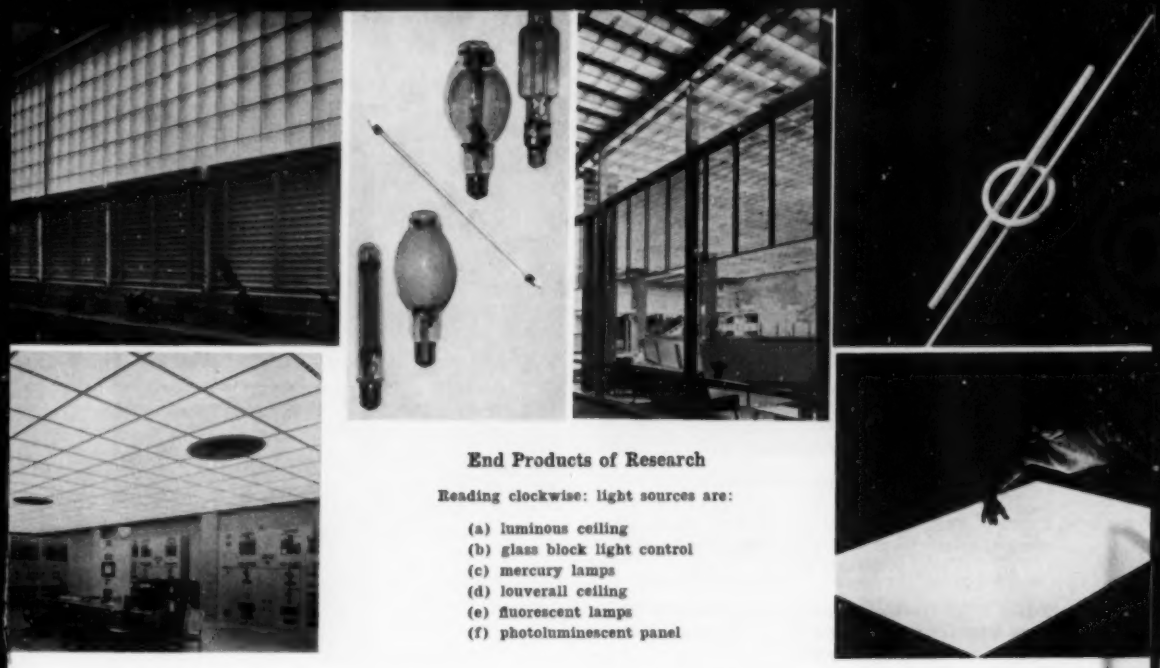
Sandee STANDARD FLUORESCENT PANELS

Widths 2" to 6" . . flat or convex uniform radius . . transparent clear or translucent white . . light stabilized . . NO DIE COST!! Write or call for estimates and samples, today.

Sandee MANUFACTURING COMPANY

4050 FOSTER AVENUE, CHICAGO 30, ILLINOIS

WORLD'S LARGEST CUSTOM EXTRUDERS OF PLASTICS FOR ALL INDUSTRIES



End Products of Research

Reading clockwise: light sources are:

(a) luminous ceiling
(b) glass block light control
(c) mercury lamps
(d) louverall ceiling
(e) fluorescent lamps
(f) photoluminescent panel

Research Gives The Answers

A Progress Report of the I.E.S. Research Fund

A number of research projects being carried out under the aegis of the I.E.S. Research Fund have already come up with answers to questions which have long plagued illuminating engineers. Some of the answers are negative, of course—but at least "now we know." Herein is described in "non-researcher" terms, the essence of the answers sought and now found through these studies.

PRODUCTS of research have revolutionized the lighting field in the last 10 years. New light sources, new materials, new designs and new techniques have all made their contribution. The I.E.S. Research Fund is now engaged in assuring that continued progress will bring even greater benefits to the consuming public and in turn to those who serve the public.

Research is not a plant of rapid growth. Slow methodical investigation is the essence of success. However, already results of everyday usefulness have become available through the Fund's operation.

New Visibility Meter

A new visibility meter to make it easier for lighting engineers to evaluate tasks in the field has been developed through the work done by Dr. C. L. Cottrell at Cornell University (Project No. 19). Illumination values in general are recommended in proportion to the difficulty of the seeing task. There must be some means of finding the relative difficulty of various tasks. Optical instruments which reduce the visibility of the task to threshold —(can barely be seen condition) are known as visibility meters. The amount of reduction is an index of the relative visibility (or less difficulty) of the task. Some instruments use varying transmission filters which reduce the brightness of the task; others use varying diffusion which obliterates the contrast of detail against its background. The new visibility meter superimposes a veiling brightness over the detail until the contrast is "washed out" while keeping the change of overall brightness within a narrow range so as not to alter the effective brightness adaptation level of the eyes. With

Figure 2. (Above) A contrast-brightness threshold meter.

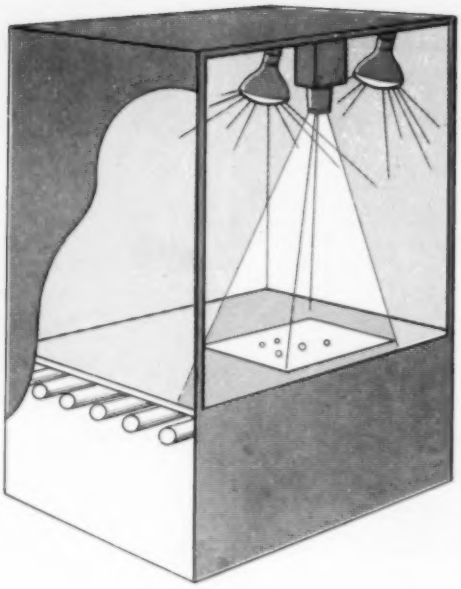
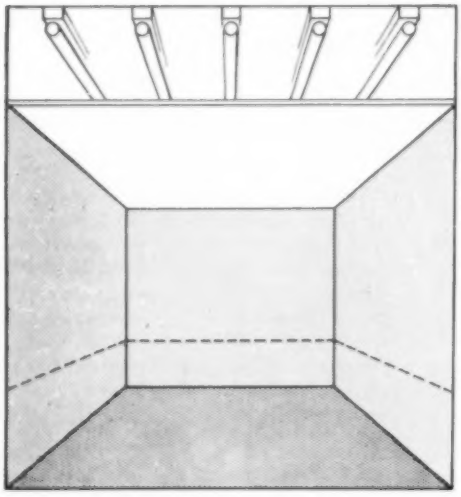
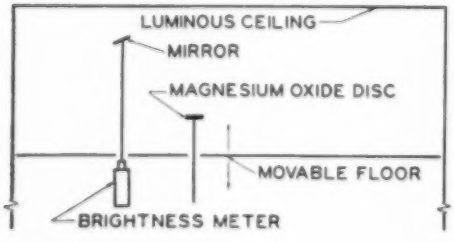


Figure 3. (Right) Booth (4′ x 4′ x 8′) for studying the effect of brightness of immediate surroundings upon performance of task.

Figure 4. (a) (Below) Model room for checking Interflection Method for predicting brightness and illumination values.

(b) Test setup.





this method it is easier to reach a threshold and obtain greater consistency among observers. This instrument should be especially helpful, not only to all field engineers but also to the Society's committees which are making studies of processes and work locations to determine the levels of illumination to recommend.

Are Low Brightness Ratios Necessary?

The Committee on Standards of Quality and Quantity for Interior Illumination published a report in 1944 recommending low brightness ratios between the task and its surrounding for comfort and efficiency. Some have questioned the visual effectiveness of such low ratios. A practical study has been conducted at Southern Methodist University by Professor R. L. Biesele, Jr. (Project No. 18). Though not exhaustive, the results confirm the emphasis on low brightness ratios as a key to maximum visual performance and comfort.

Calculating Brightness Values in Room Interiors

There was never a method of calculating brightness values on the surfaces of a room being designed until the development of the Interflection Method by Moon and Spencer in the early 1940's. This method was brought to the attention of the Society by the Committee on Standards of Quality and Quantity but it was felt that the theory should

Figure 5. Brighter area "b" affects the apparent brightness of area "a" due to scattering of light from "b" throughout the eyeball cavity.

be confirmed through experimental verification. Two studies have been made—one at the University of Michigan by Professor H. S. Bull (Project No. 4) and the other at Case Institute of Technology by Professor R. C. Putnam and Russell D. Churchill (Project No. 34)—in which ceiling sources were used. These studies have both confirmed the practical usefulness of the Interflection Method as far as light from the ceiling is concerned. It is hoped that further study will confirm its practicality with light from wall sources. The Method is available for field use through tables in Section 9 of the IES LIGHTING HANDBOOK (Second Edition).

How the Eye Sees with Various Brightness Patterns

Sharp vision occurs in a small oval-shaped area on the inner surface of the eyeball covering 1° to 2° in diameter. Areas of brightness falling near this foveal area influence the ability of the eye to see an object focused upon it. A study has been made at Ohio State University by Dr. Glenn A. Fry (Project No. 17) which demonstrates that an area of brightness higher than and in the vicinity of the task causes a veiling reflection over all the visual area which reduces the sharp appearance of the task. Through this study and other results a means is being developed whereby the effect of any brightness pattern on the ability to see objects may be calculated.

Fatigue of Outer Muscles Controlling Movement of Eyes

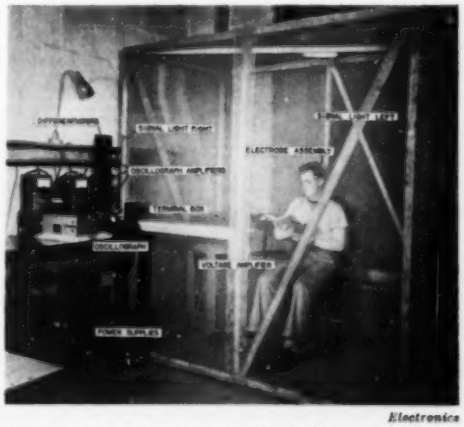
A difficult problem is to measure the effort involved in seeing. There is immediate effort, and the fatigue due to effort, exerted over a period of time. Since the eyes are constantly moving to take in the details of work, it was thought that there might possibly be fatigue built up in the outer muscles which control the movements of the eyes. Very sensitive apparatus was constructed at M.I.T. by Dr. Kurt S. Lion (Project No. 5) to measure any slight slowing down of movement. To date there does not seem to be much difference between the fresh condition and that after difficult work. It suggests the possibility that the muscles are too powerful to reflect a condition of fatigue under usual circumstances.

Is Ability to Detect Flicker an Index of Fatigue?

Another approach to the measure of fatigue has been to determine the frequency at which an observer can no longer distinguish flicker both before and after a work period. In general the eye is less able to detect flicker at the completion of the work. Illumination levels on the work were changed in a study conducted by Professors T. A. Ryan and M. E. Bitterman at Cornell University (Project No. 12) but little significant difference in the flicker frequency could be detected due to improved illumination.

Nervous Muscular Tension as an Index of Cost of Seeing

It is a commonly accepted concept that when one brings his attention to bear upon a visual task there is a muscular orientation and "tensing up" to accomplish the task at hand. The more difficult the task the greater the increase in tension can be



Electronics

Figure 6. Test setup for measuring fatigue of outer eye muscles.

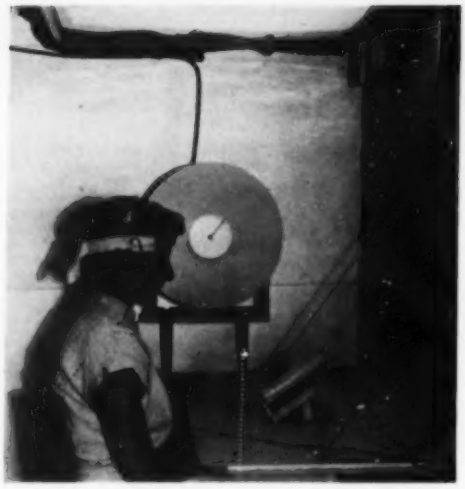
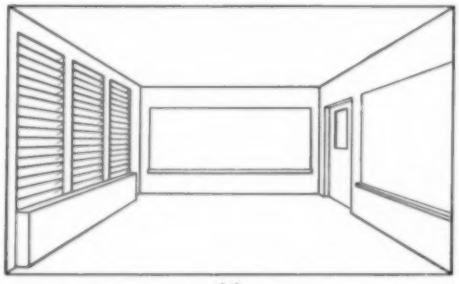
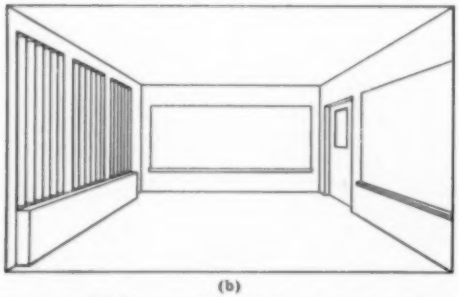


Figure 7. Measurement of nervous tension related to performance of task under different levels of illumination.



(a)



(b)

Figure 8. Model room for studying effect of (a) horizontal louvers, (b) vertical louvers under simulated sky and sun conditions.

expected. Evidences to this effect have been found by Travis, Kennedy, Mead, and Allphin at Tufts College (Project No. 23). A pilot laboratory test together with limited field tests (Allphin) on difficult visual tasks have indicated some decrease of tension under higher levels of illumination as well as some increase in output. The tests did not show differences in the case of easy tasks.

What Do Louvers Do to Daylighting in a Classroom?

Daylighting is abundant outdoors but it is always a problem as to how to get it inside, distribute it as uniformly as possible, and bring about brightness ratios in harmony with those representing comfortable and efficient seeing conditions. Various means have been advanced, among them vertical and horizontal louvers to reduce the brightness toward the eyes while permitting the light to go to the ceiling or to be directed toward the front of the room. Studies are being made of illumination and brightness at the University of Michigan by Professor H. S. Bull (Project No. 2) on a series of positions of tilt (0°, 20°, 40°, 50°) of two sizes of louvers (4- and 5-inch) and with high (50 per cent) and low (5 per cent) outside ground reflectance. Three conditions of daylighting are being used — uniform sky, non-uniform sky, and simulated sunlight.

How Do Colors of Interior Finishes Change with Various Light Sources?

For many years incandescent filament lighting was used and people became accustomed to the appearance of interior finishes, furnishings, foods, and complexions. With the advent of fluorescent lighting many of these appear different. Designers therefore became acutely conscious of the need for knowing the effect of light sources on colors used in room interiors. Many have resorted to light source boxes in which samples of material can be placed. This does not give a true evaluation because the differences are overemphasized. The eyes are adapted to the color of the lighting in the room and therefore the boxes having other light sources look remarkably different. In practice, when an observer walks into a room having a given light source he tends to adapt to the color quality of that source and the colors may look much the same as he would have expected. However, this adaptation cannot overcome completely the color difference between a room lighted with one source and another lighted with a different source so that the designer is conscious of a difference in color appearance. A study at Brooklyn College conducted by Dr. Harry Helson (Project No. 11) has

Figure 9. (a) Reflectance from road is in motorists' direction and road surface appears bright.

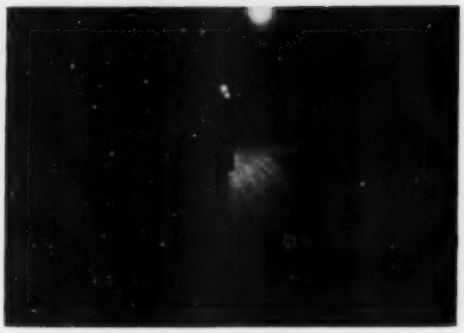


Figure 9. (b) Reflectance from road is largely skyward and road surface appears relatively dark.

resulted in a formula which predicts the change in terms of Munsell notations.

Does the Color of a Light Source Affect the Ability to See?

Studies in the past have indicated no essential difference in seeing detail and contrast between light sources having light emission in the central region of the visible spectrum. Differences have been found with light sources having light emission only at the ends of the spectrum (particularly blue) and with monochromatic sources (sodium). Recently one investigation has been reported indicating a statistically significant difference in performance of a task with incandescent filament lighting of slightly more greenish cast. Also, questions have arisen as to visual performance under the various colors of fluorescent tubes. A study is being carried on at the University of Toronto by Dr. Donald Y. Solandt (Project No. 16) in which red, blue and green lights are being used first individually to determine visual performance and later combined to produce various shades of white light to simulate the various white fluorescent lamps currently available.

How Do Reflectance Variations at Various Angles Influence Seeing of Pavements?

If one holds a mirror in a position so as to see the reflection of a light source and then substitutes a non-glossy surface in the same position, the angle is such that even for non-glossy surfaces there is a tendency for the reflection to be greater at that angle than any other angle. This is especially true if the surface is viewed at near grazing angle. Some asphalt pavements have such a relatively large reflectance at oblique angles that they may appear as bright as some surfaces having a much greater overall reflectance. In order to design lighting to produce an appearance of brightness over the pavement area against which obstructions are seen, there must be a knowledge of the angular distribution of reflectance for the pavement involved. A method of measurement has been developed at the University of Illinois by Professor John O. Kraehenbuehl (Project No. 22) and measurements are being made on a number of currently used pavement surfaces including both new and worn samples, under wet and dry conditions. Besides, from this study it may be possible to make suggestions to pavement suppliers so as to develop improved reflectance characteristics.

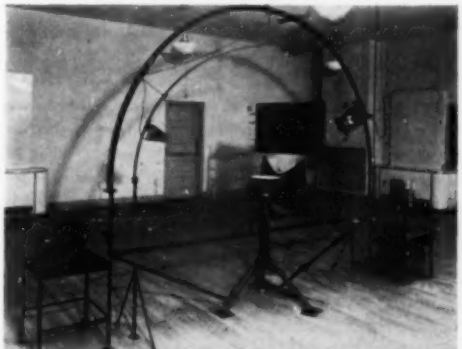


Figure 10. Apparatus for measuring distribution of reflectance from pavement samples under varying positions of light sources.

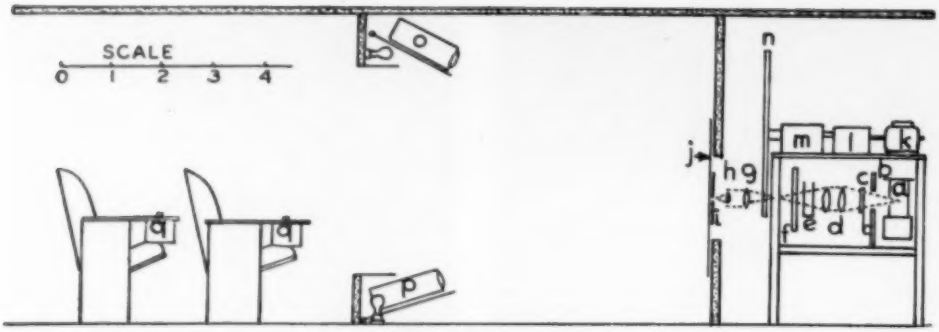


Figure 11. Test setup for measuring basic relationships of test objects varying in size, contrast, and time of exposure as affected by illumination.

Legend:

a—Lamp housing containing source
b—Stray light baffle
c—Flag shutter
d—Condensing lens
e—Fixed filter holder
f—Filter holding wheel of filter selecting mechanism
g—Condensing lens
h—The positioning of the appropriate lens for a given size of test spot
i—Circular opaque disc containing centrally the opening which sets the size of the test spot. This rests flush against j.
j—A white, translucent plastic screen which is illuminated as desired by bulbs arranged in four banks forming a rectangle which "frames" the inside of the "window" through which the subject observes.
k—Timer mechanism motor
l, m—Timer mechanism gear housings
n—One of the two timer wheels
o, p—Two of the four orientation light projectors
q—Subject's answering mechanism

An Improved Basis for Footcandle Recommendations

As darkness slowly turns to daylight objects begin to take shape until the whole scene becomes plainly visible; there is a point where a particular object can barely be seen (termed "threshold" in visual testing). As the quantity of daylight is increased the object is clearly and quickly seen. Thus beyond threshold illumination there is a margin of light necessary for quick and accurate perception. Through the manipulation of the quantity of light it is possible to determine the amount at which any object is at threshold. Further, it is possible to determine at what amount of light it is possible to see the object in the shortest length of time and with the greatest accuracy. In many industrial and office tasks only a fraction of a second can be devoted to any single detail and therefore a knowledge of thresholds for such limited time intervals is very important. This can be done in the laboratory under carefully controlled conditions. While objects in the field vary greatly in size, shape, configuration and contrast, it is necessary in the laboratory to standardize a test object which represents either an average or some of the characteristics of those commonly found in work situations.

A study is being made at the University of Michigan by Dr. H. Richard Blackwell (Project No. 30) on a basic test object of a luminous disk seen against a darker background. This disk is in several sizes (1', 4', 16' and 64') and is exposed momentarily for 1/100, 1/30, 1/10 and 1 second against a background brightness varying from 1/10 footlambert to 100 footlamberts. From this study it is expected that a family of curves will be developed showing the function of threshold illumination necessary for various sizes of a basic test object, for various degrees of contrast, for various time intervals, and for various degrees of accuracy. Later it is anticipated that other test objects will be used so as to develop a comprehensive basis for evaluating thresholds for field tasks.

When such data become available one can judge a field task in terms of the nearest test object to which it compares, determine its threshold illumination for the time interval involved in practice and the degree of accuracy necessary, add a suitable safety factor, and arrive at the final footcandle recommendations.

— C. L. C.

Trustees: A. F. Wakefield, Chairman; J. W. Barker, Conrad Berens, Anthony W. Deller, C. H. Goddard, Alfred H. Nicoll, Walter Sturrock.

Research Executive Committee: Ward Harrison, Chairman; Ralph M. Evans, G. R. Harrison, J. O. Kraehenbuehl, Howard M. Sharp, R. M. Zabel. Secretary: C. L. Crouch.

Judging Furs by Artificial Light

By FLOYD W. SELL

This installation, first prize winner of the Great Lakes Regional Conference contest for "My Most Interesting Lighting Installation," tackled and solved the problem of providing artificial light of a color sufficiently close to north sky light by which mink and fox furs can be properly judged. This entry represented the Michigan Section at the Great Lakes contest.

THE 1950 Michigan International Fur Animal Show at Michigan State College featured a newly developed artificial lighting system and for the first time in show history, mink and fox were judged successfully without resorting to natural daylight. This was a valuable contribution to the success of the show because it allowed the judges to work indoors, unhampered by December weather. Likewise, the spectators could observe the judging and inspect the prize winning animals in comfortable surrounds. Over a million dollars worth of animals were inspected on the first day because this artificial north skylight permitted the judges to work until early evening, whereas they normally would have stopped at 3:30 p.m. because of the failing natural daylight.

The new lighting system, named the "Mifurba Norlite," was the result of eight months of research and development carried on jointly by the Lighting Division of The Detroit Edison Company and the Lighting Committee of the Michigan Fur Breeders Association. Early in 1950, this Committee composed of Thomas Tiley and John Wozniak contacted Mr. Don Houghton, Farm Service Advisor for The Detroit Edison and discussed the difficulties they had encountered with the 1949 show. The show was held at the Exhibition Building of Michigan State College and because of bad weather the judging was done inside of the building, using fluorescent lamps for illumination. Considerable criticism concerning the results was expressed by the exhibitors and so a lighting development com-

Author: Detroit Edison Co., Detroit, Mich.

Mink and fox were judged successfully at the 1950 Michigan International Fur Animal Show. Spectators can observe and inspect the prize-winning animals in comfort; judges are unhampered by December weather. New artificial lighting system proves satisfactory.

mittee was appointed to prevent a recurrence at the 1950 show.

Mr. Houghton referred the problem to Mr. Lee E. Tayler, Senior Engineer of the Lighting Division and a conference was held to determine the scope of the problem and plan the development procedure. The research and development work was then assigned to Duncan Preston and Floyd Sell of the Lighting Division.

They held their first meeting at the mink ranch of John Wozniak and Sons, Milford, Michigan, early in March of 1950, to study the problem firsthand. It was agreed that the dark mink were the most difficult to light and that any lighting system that was satisfactory for this type would be acceptable for the light colored classes, as well as fox. It was further established that the most important factors in judging were:

1. Color of the fur.
2. Density, or depth of the coat.
3. Texture.
4. Evenness of pelt.

The problem of color seemed to be the most important and so it was dealt with first. Since the standard for illumination was clear north skylight it was obvious that a source rich in blue had to be found and yet it had to render accurately the very light traces of brown sometimes found in the fine under fur of the mink. The new deluxe fluorescent lamps had just been announced. An experimental setup was made whereby these lamps could be used in industrial type reflectors mounted four feet above the judging table. Sockets for incandescent lamps were also provided in the same reflectors so that both incandescent and fluorescent could be employed separately or in combination. It was determined very quickly that diffusion of the light was essential for viewing the dark mink because of their glossy coat. This was accomplished by placing a single sheet of tracing paper under the fixtures to eliminate the objectionable highlights and shadows. Eight, 200-watt incandescent lamps both standard and daylight blue were tried in all possible combinations with eight, 40-watt fluorescent lamps. Both the deluxe and standard fluorescent lamps were used separately and in combination. Correct color rendition was not obtained and the level of illumination was too low to permit satisfactory examination of the density of the fur.

These early experiments indicated the need for a high level of illumination and emphasized the importance of producing a light source very close to north sky both in color and diffusion. They also provided the background and training necessary for the eye to see some of the things that the judges would be looking for. Both Mr. Tiley and Mr. Wozniak were instrumental in teaching these fundamentals.

The development work which followed in Detroit, was checked with mink pelts rather than a live animal because it permitted much closer inspection for color and did not present a housing problem. Combinations of mercury vapor and incandescent lamps were next in the process of elimination and once again a satisfactory color combination was not found.

Because of the relatively short period of use to which the equipment would be put at the show and the need for high intensities of illumination, 500-watt photofloods were next employed. Realizing the

need for diffusion and elimination of shadow it was decided to construct a light reflecting hood, which would provide totally indirect lighting over the entire inspection table. The supporting framework was made of adjustable hanger steel channel and measured 10 feet long by 8 feet wide. Into this channel heavy white cardboard was inserted to form an arc measuring 33 inches above the base at its highest point in the center. All of the light from the photoflood lamps was directed upwards to the inner surface of the cardboard and the resultant illumination on the inspection table was free from highlights and shadow, but the problem of color remained. Light browns which appeared in the guard fur under north sky light were exaggerated under this illumination and the overall appearance of the pelt indicated a need for more blue. To correct for both of these faults the reflecting surface of the cardboard was painted a light blue and for the first time the results looked encouraging. Mr. Wozniak and Mr. Tiley were called in and after checking a variety of pelts furnished by Roberts Furs of Detroit, they requested that the equipment be moved to Milford for the purpose of observing live mink. This was accomplished and additional cardboard panels were painted darker shades of blue because it was agreed that brown was still being over-emphasized. For this test 1000-watt blue photoflood lamps were obtained. An invitation was extended to the leading mink and fox judges to come to Mr. Wozniak's ranch at Milford for the purpose of criticizing the lights and to obtain their consent to use the lighting system for judging if they were satisfied with the results.

While their comments were encouraging, approval was not obtained. However, their observations concerning one of the combinations of lamps and blue reflecting surface led to the ultimate solution.

As indicated previously, the short life of photoflood lamps was not considered to be a serious problem because new lamps could be installed for each day of the show. However, the decrease in illumination as the lamp aged together with its change in the color of light output indicated the need for a more stable light source. This was found in the 1500-watt photoblue lamp. The combination of this lamp and a special blue lacquer paint on the reflecting surface produced a light that was approved by the judges at a later meeting in Milford.

The object of eight months of research and development seems unimpressed, although he may be somewhat apprehensive over his ultimate fate.

Tempered masonite panels were substituted for cardboard by the Michigan Fur Breeders Association in the final system, which they built for the Michigan Fur Show. The entire framework was made of adjustable hanger channel and consisted of ten complete sections each 10 feet long by 8 feet wide. These were suspended from the ceiling so that the bottom edge of the framework was 7 feet above the floor. In each section four industrial reflectors mounted on a standard length of strip housed the 1500-watt photoblue lamps which burned in a base-down position. The entire system was 100 feet long, consumed 60,000 watts and was supplied by a 220-volt 3-wire service. Illumination on the judging tables averaged 130 footcandles.

In all of the development work, the element of portability was given serious consideration. The wisdom of this was realized when the entire system was shipped to Milwaukee for the North Central International Mink Show (following its introduction to the industry in Lansing) where it met with equal success.

For complete listing of the Sustaining Members of the Illuminating Engineering Society, see pages 14A, 16A, 19A and 20A.

Correlated Lighting and Design in Wurzburg Department Store

By JOHN S. FRIZZELL

General lighting in the Fashion Circle (above) is obtained from recessed silvered-mirror reflectors. Supplementary lighting is from cove with standard fluorescent strip. Inner cove around pillar has colored fluorescent strip. Combination fluorescent-incandescent units, plus spots, valance and showcase lighting (below) show off silver to advantage. Illumination on the main floor (below right) is 50 footcandles maintained, with a balance between incandescent and fluorescent. The square units have eight 25-watt fluorescent lamps and two 150-watt incandescent lamps in silvered-mirror reflectors. Spots for highlighting display are used in foreground and recessed over counters at right.

AT THE opening of the Wurzburg store in Grand Rapids, Michigan last Spring, thousands of shoppers came to admire their city's newest modern department store. What these visitors didn't realize was that they were viewing the results of an interior which had been jointly planned in close cooperation between architect, designer and lighting engineer, all the way back to the first rough drawing. The store could well be a "case study" of how vision, foresight and sound planning were applied to the overall application before building plans were even on the drawing boards. The efforts of the architects, store designers, lighting engineers, electrical contractor and building contractor were coordinated and correlated by the Wurzburg management to create a functional and efficient department store.

Intelligent planning for the lighting called for two main points of emphasis. First — that since there was a definite and useful job to be done, it was cheaper to provide illumination which met or exceeded recommended levels, than to get along with less. The second was — that mere abundance of light does not guarantee illuminating efficiency or enhance the sales appeal of merchandise. The quality and quantity of illumination had to be right; and the distribution of the light adapted to

Author: Illuminating Engineer, Pittsburgh Reflector Co., Pittsburgh, Pa.

Troffers with eggcrate louvers and matching downlights are spaced evenly throughout the shoe department (above left). Adjustable downlights with 200-watt lamps concentrate light on display.

Show window (above) uses reflectors with eccentric louvers. Also available in these windows are spots, backlighting and other theatrical-type equipment.

The Campau Room (below) has recessed reflectors for general lighting, plus fluorescent strip in cove. Two walls are edge-lighted with fluorescent strip. Illuminated pictures provide decoration.

the specific uses, if effective results were to be obtained. The combined overall planning blended combinations of fluorescent and incandescent light sources and carefully directed and controlled the quality of light. Processions of shoppers are guided by lanes of light without their being aware of such guidance. Attention is subconsciously directed to shopping areas and focal points of selling. Colors sparkle, merchandise, whether soft or hard goods, is displayed to best advantage.

Color and Lighting Design

The importance of color — harmonized with the light to bring out the colors to their fullest advantage—was especially emphasized. The effect of color at the point of purchase was most carefully considered, and the optimum balance between fluorescent and incandescent illumination was thus established for the entire store. Carefully thought out right in the "blue-print" stage was a plan whereby the store became "departmentalized" by the artistic use of 26 colors, ranging from delicate grays and pale pinks to brilliant purple and navy blue. Tests were made to determine colors well in advance, with the knowledge that all colors would be correlated since the lighting was planned to be uniform in quality throughout the store. There are 138 selling departments in Wurzburg's and each is easily identified through its own distinctive and appropriate combinations of the 26 basic colors. These colors are used in the wallpaper and paint and in the carpeting on the floors.

The basic lighting of the entire Wurzburg Store

was accomplished with fluorescent and incandescent units with wattages between the two evenly divided. An overall maintained level of 50 footcandles is on the main floor while the balance of the store averages 45 footcandles maintained. Lighting in many areas was supplemented with either incandescent or fluorescent units, as the application required. For the main floor square units were designed and built which incorporated eight, 25-watt fluorescent lamps and two 150-watt incandescent lamps in silvered mirror-glass reflectors. These units were designed to provide approximately equal output of incandescent and fluorescent illumination based on wattages. This blend set the color quality used throughout the store. Silvered-mirror reflectors were used in special applications throughout the store as were two miles of fluorescent strip.

General illumination is provided for the nine upper floors by surface mounted troffers with glass closures in hinged frames with which are incorporated incandescent downlights using lens devices. Units are either six or ten feet long. The six-foot units are equipped with either two or three 40-watt T-12 fluorescent lamps plus incandescent downlights; while the ten-foot units have two sections of two or three fluorescent lamps per section with 150-watt downlights on the ends.

Planned lighting is also applied to the exterior of the store. The merchandising value of the exterior show-windows was fully realized. Casual shoppers have their attention caught and directed to dramatic show-windows. Carefully selected, properly concealed and louvered, recessed silvered-mirror reflectors concentrate attention on the windows. Focal points of interest are added to individual windows through the strategic use of adjustable spot-lights; while back-lighting, silhouette-lighting and high-lighting with colored lenses create an infinite variety of effects.

The techniques of correlated efforts and planning on the part of all people involved in this installation could well be adapted to fit any type of installation. Closer coordination of effort is certain to result in more and more good lighting jobs, and will serve to make business, industry and public officials more and more aware of the importance of consultation with the lighting engineer in the early stages of building planning.

SERVICING PITS of the Chicago, Milwaukee and St. Paul Railroad diesel shop, Milwaukee, Minn., are illuminated by special two-lamp 40-watt fluorescent units, mounted at an angle under the walkway to light the under portion of the diesel locomotives. Illumination levels are 30 to 40 footcandles.

Photo: Day-Brite Lighting, Inc.

Lighting an Apartment Living Room

LIGHTING OBJECTIVE: To provide adequate illumination for the single occupant of a rented apartment for reading, piano playing and card games using only portable lamps (no fixed lighting in the room).

Installation at Detroit, Michigan.

General Information: The room is 12' x 17' with an 8-foot white ceiling. Walls are painted soft gray-green (40% RF) and the carpeting is gray (40% RF). The davenport is charcoal gray, the wing armchair is deep red, while the slipcover and draperies have a light yellow background with patterns in tones of gray and black touched with red. The furniture is mahogany.

Installation: Five Certified floor lamps and one Certified end table lamp are used. Two floor lamps have opaque shades, rough-textured in gray fabric. The other shades are silk, oyster-white trimmed in deep red. The opaque shades create some wall shadow and add decorative interest to the room. None of the lamps need to be moved when a card table is set up. All six lamps are turned on "low" for general lighting. Where critical visual tasks are being done, the lamps are turned to "high position."

A 12-inch ceiling enclosed globe (100-watt lamp) is used in the small foyer, and a lighted mural furnishes added decorative light.

(over)

A.I.A. File No. 31-J

Resultant illumination and brightness readings (with all lamps turned on high):

Lamp	Wattage	Illumination (footcandles) at normal reading position	Brightness (footlamberts) Shade	Wall behind shade	Wall under shade	Wall above shade
1. End Table Lamp, Translucent Shade	50-100-150	21	175	5	11.2	3.8
2. Senior Floor Lamp, West Wall, Translucent Shade	100-200-300 plus 32W fluorescent	46	75	11.3	22	3.8
3. Senior Floor Lamp, East Corner Translucent Shade	100-200-300	35	75	8	25	3.5
4. Junior Floor Lamp, East Wall, Opaque Shade	50-100-150	22	1	2.5	17.5	20
5. Junior Floor Lamp, West Wall, Opaque Shade	50-100-150	23	1	2.6	17.0	20
6. Swing Arm Lamp at Piano, Translucent Shade	50-100-150	See below*	90	12.5 3.8	12.5	15

*On left page of music 17 (average), on right page of music 51 (average), center keyboard 20, right keyboard 46, left keyboard 9.

With all lamps turned on "high" the average general lighting level in the room is 12 footcandles with a carpet brightness of 2.5 footlamberts.

Equipment:

2 Senior Floor Lamps	#256 RMCL Silver	Colonial Premier Lamp Company
2 Junior Floor Lamps	M6-607 Cadmium Base	Colonial Premier Lamp Company
1 Swing Arm Lamp	#155 RMCL Silver	Colonial Premier Lamp Company
1 End Table Lamp	(China-base)	L. Rosenfield & Company

Lighting data submitted by Mary Taepke, The Detroit Edison Company, Detroit, Michigan, as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society
1860 Broadway, New York 23, N. Y.

Lighting for the Audience

By STANLEY McCANDLESS

A definite atmosphere can be created by carefully designed lighting. The psychological factors involved are the tools of the true showman. From the standpoint of the audience it is the most important function light serves in the theatre. The paper offers abstracted highlights of a comprehensive study on this phase of "audience lighting."

TO INFLUENCE the visual reactions of the audience is the fundamental purpose of lighting in the theatre. When the stage picture not only stimulates the planned retinal pattern but also awakens the desired mental image in the mind of each person in the audience, then the real objective of stage lighting has been attained.

Few in the audience particularly notice the lighting of a production. Good lighting is such a well-coordinated part of the production that it does not call attention to itself. Even the critics seldom mention it in their reviews — and then probably to call attention to some technical error. In fact, it is a common misconception to think of lighting as a purely technical problem having to do with a bewildering assortment of electrical apparatus. To the average member of the audience and, unfortunately, to far too many members of the theatrical profession, lighting is something that the electrician can take care of — it is his problem.

The chief problem of lighting in the theatre today is not the electrician nor the lighting equipment, although neither is perfect, but how to plan and execute a desired lighting effect for the audience. This is largely the duty of the designer and his assistants. It is first a design problem. But each aspect of the design must then be related to the practical means of execution.

The effective use of light on the stage depends upon the successful coordination of four elements:

(1) The design of the object lighted,
(2) the distribution of light in relation to the object lighted and the observer,
(3) the characteristic operation of the eye, and
(4) the interpretation of the visual stimulus in the mind of the observer.

The handling of the first two is dependent entirely upon the visual effect in terms of the last two — an individual's seeing and interpreting processes. There are considerable data on items one and two, but almost nowhere has the available information on items three and four been set down in terms of stage lighting. This is a survey of the more important factors in the seeing and interpreting processes.

Author: Century Lighting Inc., New York, N. Y.

Generally speaking, for a given visual stimulus, all observers will react to a visual image in the same way, but due to the influence of training, experience, association, etc., each two individuals will interpret a sensation in a slightly different way. It is desirable to limit these differences, and to attempt to produce a uniform interpretation of a particular visual stimulus by the audience. Since only the broad limits of individual reaction can be measured, the important thing is to learn more of man's universal reaction to light and consequently to understand more clearly the functions he has come to expect it to serve in the theatre.

When the theatre first went indoors, artificial light — candles, oil lamps etc. — had to be used to provide simple "visibility." As time went on, the development of more efficient sources made it possible to be more selective. Visibility is still the primary function of artificial light but now it can be used more selectively so that objects can be made visible in proportion to their importance, or they can be revealed only to the extent that the observers' imagination makes them seem more vivid than they really are.

Artificial light has been used with increasing success to produce the effects of time of day and locale (motivation)—from painted highlights and shadows to real highlights and shadows with realistic three-dimensional scenery. Due to control and its great inherent dramatic effect, light can likewise be the tool of the abstractionist whose object is to avoid the signs of realism by understanding these qualities thoroughly. However, most playwrights and producers continue to believe that the "sure way" is the realistic approach with both scenery and lighting. Musical shows and experi-

mental productions are the exceptions, but the effort to produce realism by means of artificial light will continue to be an objective for some time to come. "Naturalism" or "motivation" are the terms used here to indicate the degree of realism in the approach of the designer.

Towards the end of the nineteenth century, there was a distinct reaction to the conventions of artificiality that the theatre had fallen into. Such men as Wagner, Craig, and Appia insisted that painted shadows and flapping backdrops were not consistent with the plastic, solid quality of the actor and the space he moved in. Perhaps the term "composition" best applies to the objective of these men and those who followed their philosophies. The modern theatre shows the importance of their teaching. Artificial light is used more extensively and with greater artistry year after year. Vivid pictorial effects, often changing with the subtlety of musical compositions, have become expected of lighting in musical shows, pageants, and displays of all kinds.

Through the ages, but more effectively since the invention of the electric lamp and the development of better instruments, control, and understanding, it has been possible to enhance the visual scene by giving it an intangible quality called "mood." The overall dramatic feeling arising out of what is seen on the stage is largely the result of carefully controlled lighting. Little that is concrete is known about the technique of producing a certain mood except through the application of that vague necromancy called showmanship.

Thus four functions of light have evolved in the theatre. They indicate the particular ways in which light can be expected to serve in interpreting the play. The ultimate visual effect depends almost entirely upon the choice, control or design of the object and the distribution of light in relation to it — both external elements — because light cannot be controlled once it enters the eye. A better understanding of the physio-psychological aspects of vision, of how the qualities of light prescribed by the characteristics of vision can be used to fulfill the functions of light, should enable the designer to provide and control these external elements more successfully.

Functions of Light

In order to cause the desired visual interpretation of a scene viewed by the audience it is necessary to understand how the individual reacts to each quality of the visual stimulus so that the object and the distribution of light that illuminates it can be designed and executed as planned.

Visibility

Visibility deals with the control of *acuity:* clearness of seeing, from large, scarcely recognizable mass to the minutest detail.

In the theatre the facial gestures of the actor are often most important and for that reason the provision and control of visibility is the first function of light. Under natural lighting conditions all objects are equally visible with the particular object of interest. The control of visibility depends on an understanding of the part each quality of light plays as a stimulus and using each in relation to the others. Thus a small object can be made equally visible with a large one by giving the former increased illumination and contrast with its background.

Projected Scenery — An example of rear projection through translucent screens. The expressionistic style of the play, "L" (by L. Atlas, lighting by George Izenour) lends itself to the use of light to present several scenes in quick succession. Use of duplicate projectors permitted the quick fading from one scene to the next.

"Our Town," as given by the Yale University Theatre, without scenery, illustrates how carefully focussed lighting reveals the essential elements. A blue filter over each of the spotlights on the young people on the stepladders (upstairs windows) conveyed the sense of moonlight.

Commercial Photo Service Co., New Haven, Conn.

a. *Intensity — (Brightness).* Experience has enabled us to establish certain standards in terms of tables of footcandles of illumination for various purposes. For example: the acting area should be lighted to a level of 5 to 50 footcandles under normal circumstances (5 for moonlit scenes and 50 for sunlit scenes. An average of 10-20 is generally adequate). Walls of box sets from between one-tenth to 10. Backgrounds may have as little as one-hundredth if they are to be obscure. Accents may be as high as 100 footcandles and if the background is bright, the average on the acting area may easily be 200 footcandles (musical comedies or farces). This indicates that there should be separate groups of instruments lighting various portions of the stage to obtain such a variety of levels of illumination.

b. *Color.* White light and tints of color give the greatest sense of visibility. Therefore, acting areas should never use strong color unless they are considerably brighter than normal. Strong colors can be used on scenery and costume where the details are unimportant. Colors in the central portion of the spectrum (greens and yellows) give a greater sense of visibility than reds, blues, and purples.

c. *Form.* Contrasts in brightness of adjacent areas or surfaces of the object of interest in ratios of one-to-one hundred can be used within comfort limits depending on the sharpness of the line of demarkation. Beyond that, contrast glare becomes a problem. Color contrasts, aside from brightness, are greatest between complementary hues and next between degrees of purity. These form the basis for a two-dimensional pattern in the eye.

Due to the two dimensional image, a sense of size, shape and position is largely a matter of education in what are called signs of *space perception:*

1—Super-position
2—Form of light and shade and shadow
3—Lines of perspective
4—Scale
5—Relative sharpness of outline, color and motion.

Another characteristic, which should probably come under movement, deals with the muscular action of the eye in sweeping over the form of the object. It is not interpreted as movement but the action is necessary in order to see the entire form of the object.

From the above, it is obvious that the *distribution* of light in terms of intensity, color and direction is all important in revealing (or concealing) things not only in their space relations to each other but in terms of their solidity and texture. In order to eliminate form, it is only necessary to reduce brightness and color contrasts between the object and the background, and on the other hand to increase a sense of form exaggerate all the above controlling factors with artificial light. Objects which inherently have little plasticity under natural light can be given exaggerated form by directing at them rays of light which cause strong contrasts of light and shade, or an object of one color can be set off against a background of another color which under natural light might be the same.

d. *Movement.* The individual must have adequate time for studying an object of interest before it becomes clearly visible. Recognizable forms, such as the actor, are expected to have movement and therefore they constitute an understandable change but other forms are apt to be distracting when allowed to move; as for instance, a flickering light or a backdrop swaying in the breeze. Significant movement must be deliberate and generally motivated.

Artificial light can be used to increase or decrease normal visibility of details without changing the

object in any respect. It is implied also that all the qualities cooperate to create visibility. Where one, such as contrast, is lacking, the other qualities can be increased to off-set the limitation. It should not be forgotten in considering visibility that things not too clearly seen (like backgrounds) may awake the imagination to supply dramatic detail more effectively than by any other means.

Naturalism (Motivation)

All playwriting is based to a degree on naturalistic conditions. Sometimes, the actor may be the only realistic visual element on the stage and even he may be considerably distorted both in makeup and action so that it becomes important to be able to reproduce natural or *motivated* effects convincingly to a large or small degree, depending upon the style of the play.

a. *Intensity*. It is impractical to reproduce the brilliance of sunlight (as high as 10,000 footcandles) on the stage. It is also impractical to expect to see under the actual illumination of moonlight (0.02 footcandles). Due to the fact that the eye is a bad judge of amounts, it is possible to have stage moonlight as much as 100 times that of the natural source and sunlight can likewise be convincing with as little as 1/100th of the natural source. It is primarily a matter of contrast. Most other sources such as fire light, lamp light, etc. must be far *less* than normal when used exposed for locale effect and far *greater* when assisting in giving visibility but they must then be well shielded.

b. *Color*. Natural light is white and man's normal interpretation of pigment colors is based on the visual effect when they are viewed under this standard. When colored light is used on the stage even though it gives far greater control, we must remember that nature has educated us to expect delicate subtleties in color. Color in light must likewise be subtle and always related to the pigment it illuminates. All motivating sources have a particular range of color. The sun and sky at sunset, the moon and fire light have definite associational colors which are often difficult to produce with artificial light, partly because of technical equipment but also because colored light conditions the eye without our knowing it.

c. *Form*. In spite of the wide range of brightness differences seen in nature a recent survey indicates that there is an average of no greater than 10 to 1. Photographic reproductions of lights and darks (seldom over 15 to 1 and less marked in color photography) give an indication of the range which might well be striven for in order to reproduce a naturalistic effect. Beyond this, every motivating source has an expected characteristic distribution which should be understood in essence. At best with available equipment only essential details can be indicated. The sun's rays are parallel and slanting and produce a single sharp shadow. The sky in all its variations from dawn to sunset, with or without clouds, produces a very subtle shadowless illumination.

Sometimes the effort to produce naturalism on the stage tends to distort the degrees of visibility of important objects. It is possible to improve on nature in this respect, in terms of visibility, provided it is within the realm of the believable. A nice balance of light and shade is created only when the sun falls on a solid object from over the shoulder at approximately a 45° angle. Intensities, colors, and directions can be balanced carefully to convey the effect of realism on a much narrower scale than nature treats us to.

d. *Movement*. It is necessary to contemplate the subtle changes of a sunset to realize how nature has established a standard which is worth striving for. In nature, however, there is no control over these effects or the appearance of objects illuminated by them. With control of the light which makes them visible, the naturalistic shapes, colors and brightnesses can be altered at will. In nature, also, there is a constant subtle change whereas the stage presents generally a static picture in which the actors give the only effect of movement.

Dramatic realism generally consists of a carefully related expression of the four qualities — a balanced exaggeration or suppression. A convincing abstraction can be created by the distortion of one —such as green sunlight—but the complete absence of motivation as in a review, doesn't even raise the question. Naturalism scarcely exists.

Composition

This deals with an aesthetic reaction which is a combination of both education and native taste, based on the standards applied to the fine arts. In the theatre it applies more to the *appropriate* use of light than to what might normally be called a purely pictorial choice. Light under control creates the brightnesses, colors, forms and shapes of the visual picture and to the extent that it has additional dramatic attributes of brightness and movement, it goes beyond the standards applied to the

Commercial Photo Service Co., New Haven, Conn.

A satiric comedy, "The Bourgeois Gentilhomme, is a brilliant spectacle where form and texture were designed to give sparkle and gaudiness. Light is used here for pictorial effect — vivid composition in a humorous mood.

judgment of the visual arts — painting, sculpture and architecture. The relative brightness range produced by a colored motion picture as compared with the range in a photograph is an example of these additional attributes.

a. *Intensity* — (Brightness). The choice of a general brightness and specific brightness differences is a matter of composition. Brightnesses in the stage picture are under control. The range is invariably greater than with a painting or a photograph. The real test is to keep it within bounds of good dramatic expression.

b. *Color* (Harmony). The use of colored light in relation to pigment presents an entirely new dimension to the normal standards of painting. The basic rule is that pigment will reflect only its apparent color under white light, and when colored light is used, pigment will appear bright or dim in proportion to the amount of its apparent color in the light. Also by contrast, pigments similar to the color of the light will appear purer to the extent that there is a complementary saturating color present. The eye, of course, interprets only the resultant effect. It cannot always tell to what extent color is due to the color of the pigment or the color of the light.

Tints of color are best used on the acting areas. Strong colors may be used on costumes, properties and settings. Some similar color must be present in the light for every pigment tone that is not to be subdued or "muddied." The greater brilliance (or graying) of color on the stage creates a problem equal to the greater range of expression. Considerable care in rehearsal is required to achieve a well-composed effect.

c. *Form* (Pattern, Accent, Tonality, Balance). A study of the brightness and color pattern of a picture indicates the effects under the standard of white light. Kodachrome viewers or projected lantern slides indicate how much more effective the increase in brightness range over a standard photograph can be, so that an entirely new set of standards must be added to the traditional tests used in judging paintings. The strong light and shade on sculpture and architecture under sunlight can only at certain times give an indication of the ideal composition in form of a solid object.

Artificial light under control makes it more possible to produce and maintain the optimum effect. It is possible (1) to control the degrees from realism to abstraction, (2) to provide a unifying tonal wash, (3) to accent or suppress details and (4) with the same objects, to alter their relationship in a composition at will.

The direction of rays, following the diagonal of a cube, brings out the best balance of highlights and shade on the actor's face, or any solid object. The choice of color can enhance the flesh tones of make-up, paints, or dyes or distort it.

In order to minimize wrinkles, pouches and double chins contrasts of light and shade must be avoided by using "flat" lighting on the acting areas and plenty of make-up.

A balanced distribution of brightnesses and colors is the main objective in the lighting of any scene. Additional details such as backlighting, the use of shade and shadow, and the blending of various areas can produce harmony, balance and sequence far beyond the usual standards of composition as we know it when applied to painting, sculpture and architecture under natural illumination.

d. *Movement* (Change, Variety). Composition in this respect can be related to a musical score. The same taste and selection that goes into the arrangement of the various chords can be paralleled in lighting by the sequence of the various pictorial effects leading up to a climax in terms of effect. The ballet is the highest form of composition in human movement. Add to this the possibility of changing the entire visual effect by means of light without in any way altering the form or pigment of the objects lighted and it will be clear what is meant by movement in composition.

Animated colored motion pictures perhaps come closer to the complete control of this quantity. Follow spots in musical shows, sunsets, and even the shifting of accent from one part of the stage to another show practical uses of this in terms of lighting on the stage.

Composition is the regulation of each lighting instrument in terms of intensity, color, distribution and movement to achieve a balanced pictorial effect beyond the production of visibility and naturalism. It is the primary function of lighting in musical and pictorial productions.

Mood

Only general suggestions can be given as a guide for creating mood. Each quality when expressed in its extremes is generally related to the tragic or unpleasant. Comedy lies between in varying degrees. Each quality has certain associational attributes basically which often must be related by exaggerating one and suppressing the other to tip the balance one way or the other — to comedy or to tragedy. For example: the dim cool light (associated with the tragic) of moonlight if it is to be pleasing (comic) must be more brilliant and more colorful than we are accustomed to seeing it in nature.

The ultimate effect depends on the ability of the designer to select the essence of any scene in terms of all the qualities of light. It is necessary only to cite various feelings to state the problem. What aspect of each quality of light produces fear, excitement, or calmness?

a. *Intensity*. Low general illumination is consistent with tragedy and high specific illumination is consistent with comedy. However, it is possible to awaken the imagination by not revealing things too clearly with low illumination.

b. *Color*. The associational and symbolic meaning of color affect each individual far more than he can evaluate. Sky is generally cool, fire and sun are hot. In terms of lighting, tragedy is generally conveyed with cool colors, monotones or extremely strong colors. Comedy is generally implied by the use of the warm colors or a reasonable variety of tints or shades of all colors.

c. *Form*. Comedy is a matter of reasonable contrasts in brightness, color and detail. Tragedy is a matter of ponderous mass, monotones or extreme brightness and color differences. The brightest and most colorful object is always the most dominant. The glitter of a crystal chandelier indicates opulence, gaiety, etc.

d. *Movement*. Comedy is consistently expressed by a fast tempo, tragedy by extreme speed or slow movement, changes from dark to bright awaken pleasure and indicate a climax. Under any condition, movement whether fast or slow commands interest and lends vitality to the visual scene. There is a very delicate line between the effect of fast and slow, barely perceptible change. The former can be almost breath-taking and the latter if carefully done creates only a sub-conscious feeling of change. This is illustrated by the difference between a dimming change in five or fifteen counts.

Conclusion

The procedure in designing a lighting effect from its conception to its realization can take its direction from the above outline. First, visualize clearly how an effect will be interpreted in the minds of the audience. Secondly, analyze what application of each of the qualities is necessary to carry this out. Then provide a distribution of light which with the objects lighted will produce the desired effect at the eye.

"Lighting for the Audience" implies a greater scope than the confines of the theatre. While artificial light is one of the obvious tools of the designer in the theatre (including motion pictures and more recently television) and consequently is more extensively used than in any other field, display men, interior decorators, and architects are beginning to think of light as a plastic medium that can and must be designed wherever appearance and dramatic effect under artificial light are important. It is something more than just fixtures and instruments. It is visibility, comfort, composition and atmosphere — the fundamental objectives that deal with individual visual reactions. Inasmuch as most people spend a large portion of their waking hours under artificial light the "audience" includes almost everyone and the time will come when the universal importance of well designed lighting where we work, play and even where we live is appreciated.

Why We Should Analyze the Industrial Lighting Problem

By L. COURT BUTLER

It is not intended in this article to compass the theoretical lighting of any specific type of industrial plant; to be adequately dealt with, such a subject would be more voluminous than is intended for this brief discussion on "lighting the industrial plant." It is, rather, intended to discuss certain modus operandi which may be applied generally in making industrial lighting surveys.

SPATIAL lighting, *i.e.*, general illumination, although important, is not the ultimate solution of the lighting needs of the industrial plant. The work, per se, must be lighted and the lighting technique prescribed should be in accordance with the severity of the seeing tasks to which the eyes may be subjected by the use of the machine tools, etc. employed in the manufacturing process. In other words, the evaluation, quantitatively and qualitatively, of the illumination need for the different operations should always be computed for industrial installations, on the basis of eye comfort in seeing the work.

Consequently, lighting an industrial plant requires a special aptitude and experience. This is primarily because a comprehensive survey of the mechanical and manual operations employed in a manufacturing process and an analysis of the seeing tasks peculiar to the operations should always precede any attempt to forecast the lighting needs. It may be advisable in some cases to make time studies to obtain criteria for gauging the illumination needed on various machines for optimum seeing. Investigations may also disclose the extent of comfort or discomfort experienced by mechanics performing precision machine-tool and other close tolerance work, and also guide the engineer in prescribing lighting suitable for the work.

These methods of seeking solutions to industrial lighting problems were included in the general modus operandi of the Cooper-Hewitt industrial lighting specialists. Although these sales-engineers had to combat stiff resistance to the color of Cooper-Hewitt light, they were eminently successful in promoting the use of their product and earned a unique distinction as experts in all fields of industattributed to: (1) their knowledge of lighting including the advantages and disadvantages of incandescent and gaseous discharge light sources which enabled them to expound the visual properties of the light media they promoted, (2) to the thoroughness of their methods.

It was the general practice of these engineers to make exhaustive investigations in every plant in the many branches of industry, into which they gained entré. By collecting and cataloguing manufacturing, processing, and production data, during the course of an investigation, they possessed an abundance of criteria with which to detect and comprehensively explain specific instances of lighting deficiencies, which further served as the bases for their recommendations.

It is incontrovertible that the skilled worker can operate more proficiently and expeditiously when the light on his work has been scientifically planned to serve the specific seeing requirements of the work. Precision in lighting the *work* is as essential to efficient performance as precision tools and machinery. Lighting which facilitates seeing the work facilitates precision in the work operation.

When illumination is adapted to the seeing task the eyes function with less muscular fatigue — less strain. Conversely, when the lighting fails to supply the stimuli (light wavelength energy) required by the visual organism for seeing the object clearly, and the nerve cells called the rods, which produce the black and white photography in the eyes, are not sufficiently sensitized by the light to produce a sharp image of the object on the retina, the muscles that focus the lens of the eye for proper accommodation to the seeing task, increase their "pushing and pulling of the lens" function to an excessively rapid rate in trying to find a proper focus for photographing the object. When this status quo is continued for protracted periods of critical seeing tasks, performed under adverse seeing conditions, it becomes aggravated and may result in serious strain to the eyes.

In a paper by the late Dr. Ferree and Dr. Gertrude Rand, read before a convention of the ophthalmologists, these scientists stated: "Eyestrain leads rapidly to fatigue and exhaustion, to

Author: President, Court-Butler Lighting Inc., Meridan, Conn.

deformities, slight in their physical magnitude, but great in their functional importance, to inflammation and congestions and to hypertensions and other conditions not found in a healthy eye. It leads sympathetically, to functional disturbances in other parts of the body. Like any other organ of the body, if the eye is to remain healthy, it must be put into a situation calling only for the healthy exercise of its normal functions."

It seems logical to conclude from the above that besides being harmful to the eyes, the neuromuscular tensions produced in the eyes by inadequacies in illumination and communicated, through optic nerve, to the nerve centers of the body, deplete nervous energy, and result in general fatigue, loss of initiative, and lessening of work output.

It has been said that "Such as the action is of the rays of light is on the retina, such is the appearance of the object is color and figure, distinctness or indistinctness, brightness or faintness," *Essay on Vision*, by George Adams.

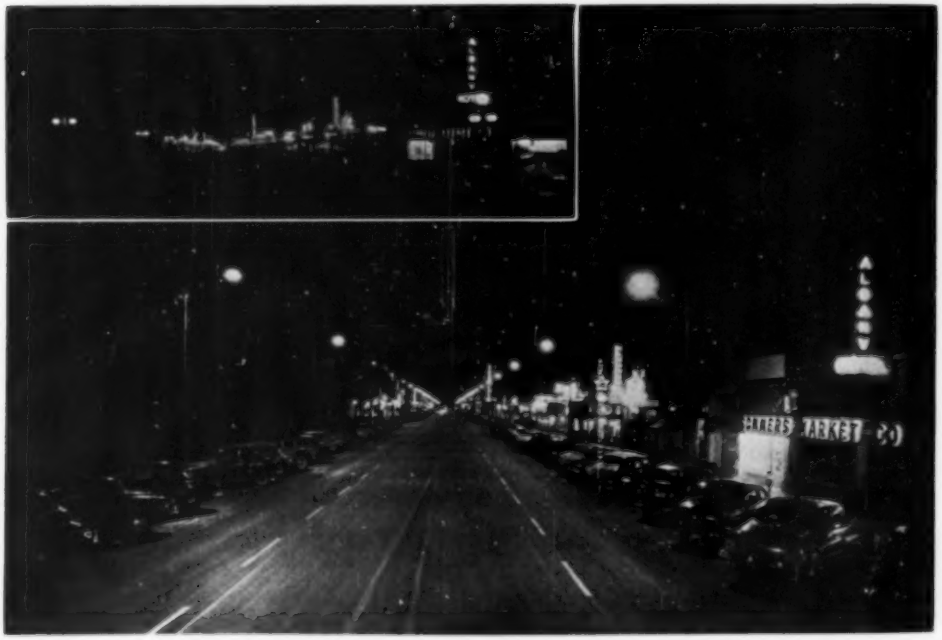
Thus we find cogent reasons why industrial plant managements should be receptive to scientific analyses of their lighting facilities, and why the lighting engineer should thoroughly explore this phase of lighting the industrial plant where maximal seeing is so necessary to safety, health, morale, and efficient production.

New Mercury Installation Boosts Illumination Levels

Eight blocks of 70-foot-wide Tejon Street, Colorado Springs, Colo., have already been relighted in a long-range street lighting modernization project for the city's main business artery.

The installation consists of 85 mercury vapor luminaires equipped with 15,000-lumen lamps. These are mounted 30 feet high on brackets which extend six feet over the roadway from steel trolley poles spaced 100 feet apart on opposite sides of the street. The illumination level is in excess of two footcandles. Power consumption of the system is nine watts per linear foot.

The old system (see inset) consisted of various types of incandescent units. One side of the street had 200-watt multiple lamps mounted 18 feet high and spaced at 100 feet. The other was lighted by four- and five-ball clusters mounted 12 to 14 feet high, spaced 50 feet apart. Power consumption was four watts per linear foot. Photos courtesy General Electric Co., Schenectady, N. Y.



Lighting a Store

LIGHTING OBJECTIVE: To provide general and supplemental lighting throughout a new department store.

Figure 1.

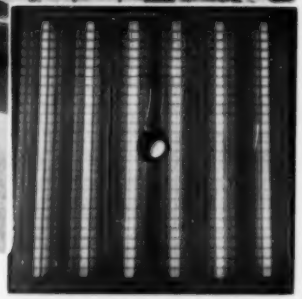


Figure 2. Close-up of 5-foot square louvered luminaire with gimble ring and PAR-38 spotlamp.

Installation at Wieboldt Stores, Inc., Church and Oak Streets, Evanston, Illinois; architects: Holabird, Root and Burgee.

General Information: The second-floor dress department has an 11-foot ceiling and is decorated as follows:

Ceiling	light gray plaster	70% RF
Floor	mottled gray linoleum	10% RF
	gray carpeting	15% RF
Counters and wall cases	natural wood	35% RF

Lighting Installation: A general lighting level of 40 footcandles is provided by recessed louvered 5-foot square luminaires (All-bright Electric Products Co. #R5L-685) mounted on 13-foot centers. Each unit contains six 85-watt warm white fluorescent lamps. An 18-inch wide center section is designed with provision for inserting a gimble ring for use with spot or flood lamps (see Figure 2). The louver cells measure 2 x 2 x 1½ inches with a shielding angle of about 36 degrees in both directions.

Near the escalator are installed a row of louvered units (All-bright #RES-SML-240-T-2) each containing two 40-watt fluorescent lamps.

Brightnesses are as follows:

Ceiling	9 ft-L
Wall cases	14 ft-L
Luminaires (30 degrees below the horizontal)	250 ft-L
Counters	18 ft-L

Lighting data submitted by B. H. Leishman, All-bright Electric Products Company, Chicago, as an example of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society
1860 Broadway, New York 23, N. Y.

Series XVI 8-51

A.I.A. File No. 31f

Good Capacitors—A "Must" in Quality Ballasts

By R. F. ROWE
L. E. GREGORY

FAR TOO MANY lighting men fail to realize fully the vital role capacitors play in the operation and performance of fluorescent lamp ballasts. To establish a basis for discussing this important component of a ballast, let's begin with an explanation of what a capacitor is, what it is called upon to do in a ballast, and how it performs these tasks.

What Is a Capacitor?

Nearly all of us can recall the fundamental definition of a capacitor, namely, "two conductors separated by a non-conductor." In ballast capacitors, the conductors are thin sheets of metallic foil, and the non-conductor consists of thin sheets of paper. Long strips of paper and foil are wound in a compact roll to occupy minimum space. This roll is housed in a steel container, impregnated with a liquid of high dielectric strength, and then hermetically sealed into its container. This description of a typical ballast capacitor is, of course, overly simplified, but it is fundamentally accurate.

What Does a Ballast Capacitor Do?

Capacitors have three important jobs to do in ballasts which operate fluorescent lamps on common alternating-current distribution systems. These are (1) power-factor improvement, (2) suppression of radio-frequency energy, and (3) aid in lamp starting. Let us consider each of these functions in basic terms.

Power-Factor Improvement

A load power-factor near unity (100 per cent) is necessary to obtain the best utilization of power-generating capacity and distribution facilities. The power-factor of an uncorrected ballast load, as seen by the power line, is in the order of 45 per cent. By correcting to 90 per cent power factor the same amount of power is delivered to this load with only one-half as much line current.

From another point of view, the same current delivered to a 45 per cent power-factor installation will light twice as many lamps in a 90 per cent power-factor installation. Consequently, capacitors, which provide a simple way to improve ballast power factor, are an important item in the overall economy of a lighting installation.

Figs. 1, 2, and 3 illustrate how capacitors are used in ballast circuits to improve power-factor.

In the circuit illustrated by Fig. 1, the capacitor is so chosen that current passing through it is equal to the current passing through the lamp circuit. Since the power factor of the capacitor current is leading and that of the reactor-lamp combination is lagging, the net result of the combination is nearly unity power factor.

In Fig. 2 the same result is achieved by selecting a capacitor (now in series with the lamp circuit) which dominates the other elements and results in a leading power factor for the lamp circuit. This leading component of current is then balanced by proper adjustment in the autotransformer so that the exciting current, which is lagging, brings the over-all power-factor to a high value.

In Fig. 3 the two fundamental lamp circuits (Figs. 1 and 2) are combined and their respective leading and lagging currents compensate to result in high power factor for the combination.

From this brief discussion it is obvious that capacitors are a basic tool for the power-factor improvement of all conventional types of ballast circuits.

Suppression of Radio-Frequency Energy

An unfortunate characteristic of a fluorescent lamp is that it may be a source of radio-frequency energy. A lamp operating from a circuit to which a radio is connected can be an annoying source of interference. Here, a capacitor is called upon to perform another important service. A unique feature of a capacitor is the very low impedance path it presents to high-frequency energy. This feature can be utilized nicely to bypass or "short out" radio frequency currents that would otherwise enter the supply circuit and show up as interference with radio reception. Figs. 4 and 5 show how capacitors for suppression of radio interference energy are commonly used.

In Fig. 4 suppression is done at the lamp; in Fig. 5, at the supply line. In either case the capacitor may be incorporated into the ballast housing. More

Authors: Ballast Engineering Div., General Electric Co., Ft. Wayne, Ind., and Small Capacitor Engineering Section, General Electric Co., Ft. Edward, N. Y., respectively.

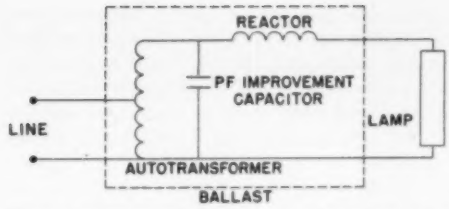


Figure 1. Single-lamp ballast with parallel power-factor improvement.

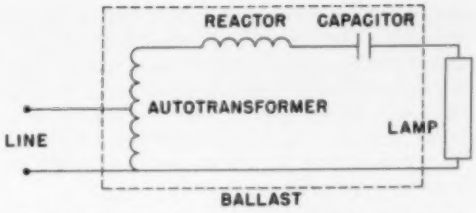


Figure 2. Leading circuit, single-lamp, high-power-factor ballast.

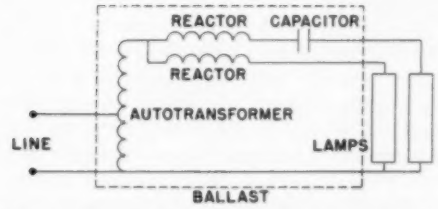


Figure 3. Two-lamp circuit employing capacitor in lead branch.

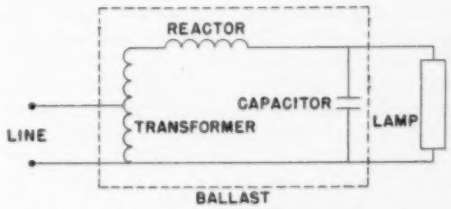


Figure 4. Use of a capacitor to suppress radio interference at the lamp.

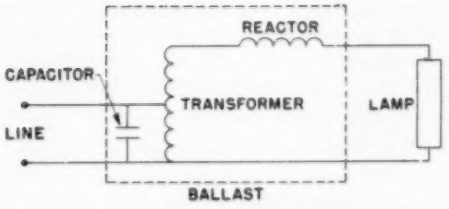


Figure 5. Use of a capacitor across the supply end of a ballast to suppress radio interference.

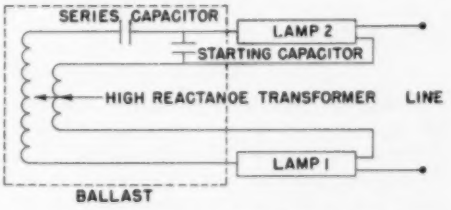


Figure 6. Capacitor start, series ballast.

elaborate line filters are also available on the market. They utilize several capacitors, or capacitors in combination with inductance coils in a filter network. Such line filters are furnished as individual units separate from the ballast.

Starting Aid

The third fundamental function of a ballast capacitor is to act as a means of starting the fluorescent lamp. Consider the circuit shown in Fig. 6. If a ballast must furnish certain open-circuit voltage to start one lamp, can two lamps in series be started without materially increasing this ballast voltage? Ballast designers have again turned to a capacitor to answer this question affirmatively. A properly chosen and located starting capacitor makes series operation of two fluorescent lamps practical and affords great savings in size, weight, and material content of the ballast. Simply, this is the way the circuit works: Initially, the ballast voltage appears across lamp No. 1 (tracing the circuit will confirm this statement). This voltage strikes the first lamp. The current conducted by this lamp passes through the starting capacitor which increases the voltage across that capacitor and the second lamp to a point at which the second lamp breaks down. Since the lamp starting voltage has been applied alternately to each lamp during

the starting cycle, the magnitude of this voltage is not substantially greater than would have been required to start a lamp in a single-lamp circuit. The entire starting cycle is, of course, of short duration. Obviously, the starting capacitor plays a key role in the process. The series capacitor is used in a manner typical of the circuit described earlier in connection with Fig. 2.

Capacitor Quality Pays

The preceding paragraphs outline briefly the important functions of capacitors in the operation of a ballast. Since capacitors do perform such vital functions in a ballast, it is obvious that capacitor failure will in many cases make the ballast completely inoperative. The conclusion must inevitably be this: Capacitor quality and proper capacitor application cannot be divorced from ballast quality and proper ballast performance. Reputable ballast manufacturers insist on quality capacitors. The problem, however, is more complicated than appears on the surface. Let's examine some of the critical considerations.

Quality in a capacitor is represented essentially by low loss, low power factor, and long life. Low loss and low power factor are electrical characteristics and depend on proper selection of materials and manufacturing technique. Long life depends on these also, as well as conservative rating and proper application.

Mechanical Characteristics

In order to obtain desirable characteristics, ballast capacitors are almost universally liquid-impregnated and hermetically sealed in metal cans. The reason a liquid impregnating material is used, rather than a solid is that no resin or other solid dielectric has yet been developed that provides the combination of high dielectric strength, low dielectric loss, negligible moisture transmission, good physical strength, and low cost. No satisfactory substitute for a steel case has been developed to date. The most vulnerable feature of liquid-impregnated dielectric is its deterioration from moisture absorption when exposed. Impurities in the impregnating medium or improper impregnation, such as failure to remove all the moisture from the paper, can cause a prodigious increase in power factor coefficient and hence in power loss, particularly at or near operating temperature. Attempts to develop plastic containers have thus far been defeated by greater costs than for steel and relatively high moisture transmission. Terneplate (lead coated steel) or tin plate is the most commonly used can material and has proved itself over the years from the standpoint of durability.

Some capacitors are enclosed in fabricated cans with soldered or welded seams; however, the most reliable construction has been found to be a deep drawn cup with a double rolled-seam cover. The double rolled-seam, using a plastic compound to fill slight irregularities in the fit has two great advantages over a soldered seam. First, it is not susceptible to damage by heat or handling, and second, it is uniform and not susceptible to faulty soldering technique. Reasons for the superiority of drawn cases are reliability and uniformity. Obviously there can be no side and bottom seam leaks from faulty soldering in a drawn can with no soldered joints.

Being an electrical device, a capacitor requires electrical connections. These are provided by insulated bushings. One extremely simple and effective bushing consists of a collar of silicone rubber extending through an extruded section of the cover and compressed longitudinally by means of a stud welded to a terminal. A conductor from the capacitor electrode is welded to the stud at assembly. (See Fig. 7.)

Protective surface finish is not a major problem on ballast capacitors. The majority of ballast manufacturers seal the components in the ballast housing with potting compound, hence, the chief requirement is that the can surface be protected during manufacture, shipping and storage. Ordinary terneplate or tin plate, even after the drawing operation, is adequate protection except where excessive humidity or corrosive atmosphere is likely to be encountered.

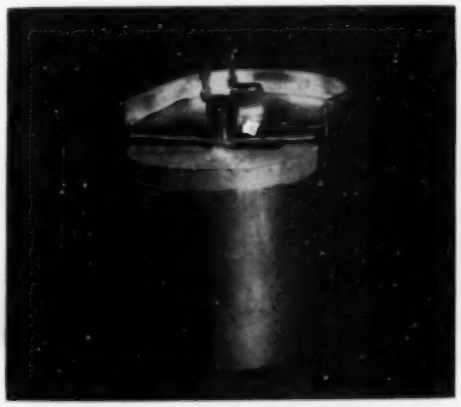


Figure 7. Cutaway view of a capacitor showing construction of bushing, case, and the position of coiled aluminum foil.

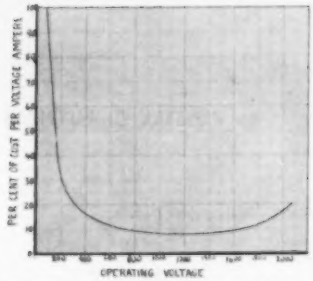


Figure 8. Capacitor cost as a function of operating voltage showing reversed trend as voltage increases.

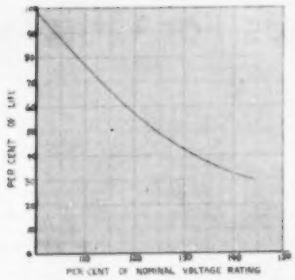


Figure 9. The tremendous penalty in capacitor life caused by operation at excessive voltage. (Based on 70°C ambient.)

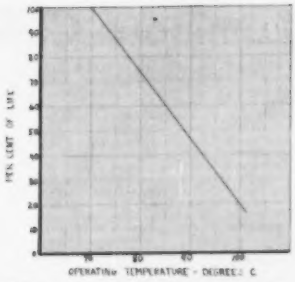


Figure 10. The steep drop in capacitor life as operating temperature is increased above 70°C nominal.

Economics of Ballast Capacitor Design

Long life, as mentioned before, depends not only on proper materials and manufacturing technique but also on conservative rating and proper application. Here the ballast designer and the capacitor designer must cooperate to obtain quality. To begin with, the ballast designer may select an economical operating voltage for a given volt-ampere requirement. One characteristic of paper dielectric capacitors that may not be self evident is that below a certain voltage there is no further reduction in cost by reducing voltage. This is true because, as the paper thickness is decreased, the cost per pound required to provide satisfactory life is increased. The ballast designer, therefore, has the problem of selecting a capacitor and reactor combination that places the most economical voltage on the capacitor. It may be seen from Fig. 8 that in general the higher the operating voltage for a given volt-ampere rating the lower the capacitor cost, up to a voltage in the order of 700-800 volts.

The capacitor engineer can take capacitor requirements for a given ballast and making use of experience, know-how, and life test data accumulated over a period of years, produce a unit conservatively rated at the specified voltage. Voltage rating is obviously of utmost importance since a capacitor to give adequate life must be rated conservatively and since failure usually means expensive replacement of the entire ballast.

All too often the ballast designer makes impractical demands of the capacitor designer to reduce size, or unit cost, or both. The only possible way the capacitor designer can meet this demand is to reduce the dielectric thickness, *i.e.*, increase the voltage stress. Fig. 9 illustrates the effect on life of the capacitor of increasing the voltage stress above nominal while operating in a 70°C ambient temperature.

Take, for example, a capacitor actually used at 110 per cent of nominal voltage rating. The size reduction obtained would be about 20 per cent. However, the cost reduction for such a size reduction seldom exceeds 5 per cent. Again, Fig. 9 shows that the reduction in life would be about 25 per cent, a very high price to pay for the small initial savings—and it should be kept in mind, again, that *capacitor* failure usually means a *ballast* replacement.

Another very important consideration is operating temperature. For capacitors in common use today, 70°C represents the maximum continuous case temperature at which nominal life may be expected. The effect of temperature on life for a given design at rated voltage is indicated in Fig. 10.

It should be noted that an increase of 10°C in ambient or operating case temperature decreases life about 25 per cent. An increase of 20°C cuts life to less than half of the nominal value at 70°C.

Quality Insurance

Having obtained the desired capacitor, designed for the job with both mechanical and electrical characteristics built into it, it is then up to the ballast engineer to insure that quality. This he can and must do by using it at no more than its rated voltage and protecting it from temperatures in excess of that for which it was designed. Ignoring either the rating or proper temperature in using ballast capacitors will cancel the inherent quality of even the best capacitors. The result is poor ballast operation or ballast failure traceable to capacitor failure. In any event the user loses confidence in fluorescent lighting and his troubles add unnecessarily to complaint costs in the industry.

It is imperative that the vital importance of capacitors in ballasts be recognized by the industry. Fluorescent lighting economy is based on use of quality ballasts; this in turn hinges importantly on proper application of well designed capacitors.

Luminous Ceilings For Offices

By RUSSELL C. PUTNAM

LOW intrinsic brightness, both direct and reflected, of the luminous ceiling is an important factor in producing optimum seeing conditions in an office. Recent developments in the manufacture and application of luminous ceilings make their use practical, as evidenced by the growing number of installations in offices around the country.

Photometric measurements of brightness and illumination levels allow the illuminating engineer to make comparisons with accepted standards and with other types of lighting installations. In order to obtain such information on actual installations, two private offices in the northeastern Ohio area were selected for study.

The office of the C. F. Denzer Company, Sandusky, Ohio (Fig. 1), has a dual purpose: It is a showroom for luxurious office furniture, as well as an executive office. As a showroom the furniture is changed periodically and therefore no brightness readings were taken of the chairs, davenport, bookcase or desk top. Brightness readings were taken only of the permanent parts of the office, such as the luminous ceiling acoustical baffles, walls and carpet. The reflectances of the furniture should comply, of course, with the specifications of the Illuminating Engineering Society.

The brightness pattern of the permanent parts of the office (Fig. 2) show very comfortable brightness ratios. A comparison with the ratios recommended in the I.E.S. Recommended Practice of Office Lighting (Table I) is particularly significant. It shows that this office is not only well within the maximum ratios permitted, but that most of its brightness ratios are better than the 3 to 1 ratio and approach the 1 to 1 ratio that are specified as being theoretically desirable in Report No. 1, "Brightness and Brightness Ratios," of the Illuminating Engineering Society.

The average lighting level in the office was 62.5 footcandles after the lamps had been in operation about 400 hours. Standard cool white fluorescent lamps are mounted in continuous rows approximately eighteen inches above the plastic ceiling, each row being directly above each acoustical baffle and extending the length of the room. A row consists of two 48-inch, T-12 lamps and two 72-inch, T-12 lamps, so the room has a total of eight 48-inch, T-12 and eight 72-inch, T-12 lamps, all operating at approximately 430 milliamperes.

TABLE I.—Brightness Ratios.

Maximum Recommended in I.E.S. Recommended Practice of Office Lighting (Lower ratios would be desirable)	OFFICE C. F. DENZER CO. SANDUSKY, OHIO
Between task and adjacent surroundings	
3 to 1	Depends on reflection factor of desk top and desk pad. Recommendations could be met with lighter desk top and pad than shown in Fig. 1.
Between task and the more remote surfaces	
10 to 1 or 1 to 10	2.6 to 1 between task and floor 1.6 to 1 between task and lower wall 1.4 to 1 between task and middle wall 1.3 to 1 between task and upper wall 1.1 to 1 between task and acoustical baffle 1 to 1.3 minimum and 1 to 2.5 maximum between task and luminous ceiling
Between luminaire and adjacent surfaces	
20 to 1	2.6 to 1 maximum between luminous ceiling and acoustical baffle 2.1 to 1 maximum between luminous ceiling and adjacent wall
Anywhere within the normal field of view	
40 to 1	5.6 to 1 between the brightest part of the luminous ceiling and the carpet

TABLE II.—Approximate Reflectances of the C. F. Denzer Office, Sandusky, Ohio.

Reflectance of ceiling plenum	85%
Reflectance of white enamel of baffles (23% perforation)	87%
Walls	80%
Floor carpet	45%
Drapes	38%
Desk pad	58%
Desk top	30%
Leather chairs	15%
Walnut furniture	10%

The reflectances of the room and furniture (Table II) indicate good utilization of light through interreflection due to the high reflectances of the carpet and walls as well as the desirability of lighter finishes and leather of the furniture for a harmonious and comfortable brightness pattern.

Bright light sources in an office may give reflected images from specular surfaces, such as shiny desk tops or glossy paper, and present a very important source of annoyance and eye fatigue. Even fluorescent luminaires that are well shielded to re-

Author: Professor of Electrical Engineering, Case Institute of Technology, Cleveland, Ohio.

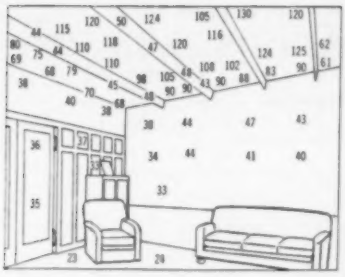
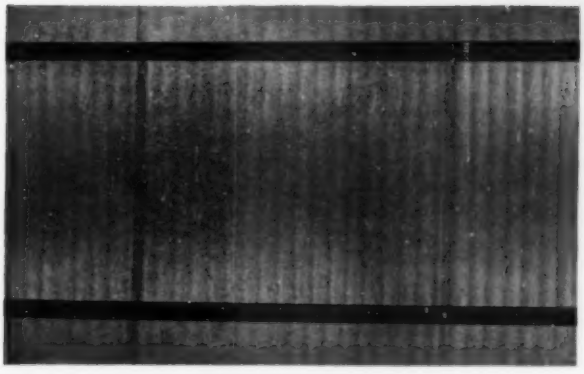


Figure 1. (right) Office of the C. F. Denzer Company, Sandusky Ohio, is lighted by fluorescent lamps behind an acoustical ceiling.

Figure 2. (above) The brightness pattern of the office as seen by the executive seated at his desk. Brightness values are in footlamberts.



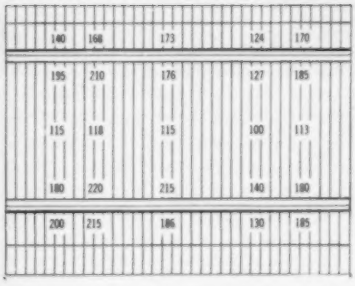
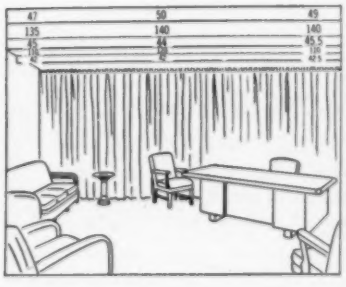


Figure 3. (left) A view of the luminous ceiling as seen by the work.

Figure 4. (above) Brightness values in footlamberts of the luminous ceiling.

Figure 5. (right) The same office viewed in a direction perpendicular to the acoustical baffles.

Figure 6. (below) Brightness pattern of the ceiling and acoustical baffles. Values are in footlamberts.



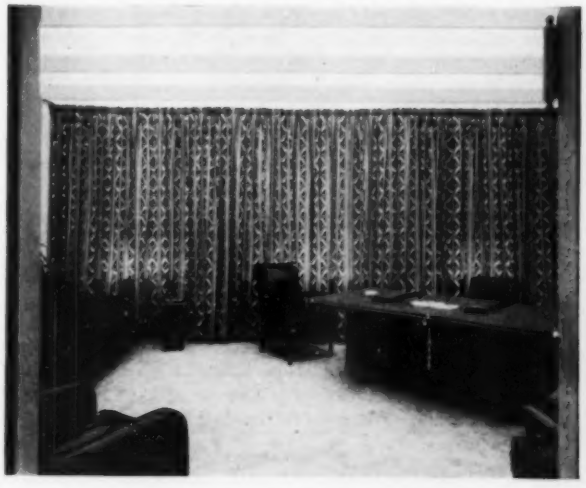


Figure 7. Office 206 of the Williamson Building, Cleveland, Ohio, lighted by cool white fluorescent lamps behind a luminous ceiling.

duce direct glare may have a maximum brightness in the direction of the work exceeding 2000 footlamberts if they are open at the bottom. The brightness in the direction of the work of the luminous ceiling is very low (Figs. 3 and 4), the maximum being 220 footlamberts. This low maximum potential brightness that might be reflected from the work is of particular advantage in offices where specular surfaces are involved.

In many offices the field of view may be perpendicular to the direction of the acoustical baffles. Indeed in large offices this may be desirable because of the shielding effect of the baffles which further increases the visual comfort. Brightness ratios between the luminous ceiling and the acoustical baffles are excellent (Figs. 5 and 6) showing ratios of 2.6 to 1 minimum and 3.2 to 1 maximum.

TABLE III.—Brightness Ratios.

Maximum Recommended in I.E.S. Recommended Practice of Office Lighting	OFFICE 206 WILLIAMSON BUILDING CLEVELAND, OHIO
Between task and adjacent surroundings	
3 to 1	Estimated as 4.7 to 1, because of dark executive-type desk
Between task and the more remote surfaces	
10 to 1 or 1 to 10	8.4 to 1 between task and wood panelling 2.26 to 1 maximum between task and wall 1 to 1 (approximately) between task and acoustical baffles 1 to 3.3 maximum task and ceiling
Between luminaires and surfaces adjacent to them	
20 to 1	3.9 to 1 maximum between luminous ceiling and wall 3.4 to 1 maximum between luminous ceiling and acoustical baffle
Anywhere within the normal field of view	
40 to 1	31 to 1 between the brightest spot in the ceiling and the glass panel in the door. (The dark furniture was not considered in this ratio as very little furniture was in the normal field of view of the executive seated at his desk.)

Office 206 of the Williamson Building, Cleveland, Ohio, (Fig. 7) has a similar brightness pattern. The brightness ratios, as determined from the position of the executive seated at the desk, are summarized in Table III. Higher reflectances for the furniture and the wood panelling would improve these ratios although the ratios are all better than the limiting values with the exception of that between task and the adjacent surroundings which is out of line because of the dark finish (15 per cent reflection factor) of the desk top. The average lighting level on the desk was 75 footcandles after 100 hours operation of the lamps.

Both of these offices have excellent light distribution with minimum shadows and a relatively high level of illumination. The brightness ratios are excellent, with the exception of the furniture which is too dark. The outstanding characteristic of both offices is the absence of reflected glare, caused by the low maximum potential brightness of the ceiling.

September I.E. Puts Technical Conference "On the Road"

ILLUMINATING ENGINEERING for September will be the Annual National Technical Conference Issue, featuring author-written abstracts of every technical paper presented at the Conference . . . putting the Conference itself on the desks of those readers who could not be present. For all that is new in lighting, for information and for future reference don't miss the September Issue.

Specular and Diffuse Reflectances of Printing Ink and Common Papers

By H. M. SHARP
J. F. PARSONS

THERE are little published data on the specular and diffuse reflection factors of the various papers used in everyday reading and office routine. The same pertains to the inked characters that appear as printing on these same papers. Notations are found as to the reflection factor of dull ink, but what does it mean? The reflection factor of interest is that of the ink on some surface. It is not a constant but depends upon the composition of the paper. Such data are necessary in studies of the effect of reflected brightness upon visibility.

The average investigator does not have the facilities for determining the reflectance of a small printed character. A large area can be measured easily. If, therefore, an impression of, let us say, a rectangle can be made in conjunction with a normal printing run, the reflecting characteristics of the rectangle can be assumed to be the same as those of the printed letters.

A number of common work papers were selected in consultation with a printer. A block of type was set up consisting of a paragraph and a rectangular bar. This form was placed in a hand press, and a number of sheets of each specimen were run off by the printer at one time. Thus the same ink and the same pressures were used on all test papers.

Experimental Setup

The investigative procedure described here is simple and offers possibilities for extension of this type of work.

(Fig. 1) A diffused high brightness source was attached to a large reflecting panel. In this instance a 500-watt white bowl lamp was used. Voltage was maintained at rated value during readings. This lamp has such a high brightness that the brightness that the brightness of its reflected image can easily be measured by means of a Luckiesh-Taylor Brightness meter. The reflecting panel produces a high level of diffuse illumination on the test samples. Therefore, accurate measurements of the diffuse brightness of ink and paper can easily be made.

A person seated at a desk looks down at a horizontal reading task at an angle of about 30° to 45° from the vertical. Arrangements were therefore made to measure the specular and diffuse reflection factors within these angles. A mirror was placed in the appropriate work position. One Luckiesh-Taylor meter (No. 1) was directed toward the image of the glare source and remained fixed in that position. Another Luckiesh-Taylor meter (No. 2) was set to measure the diffuse brightness at the same point. The papers were placed over the mirror and simultaneous readings of specular and diffuse brightness were taken with both instruments. The

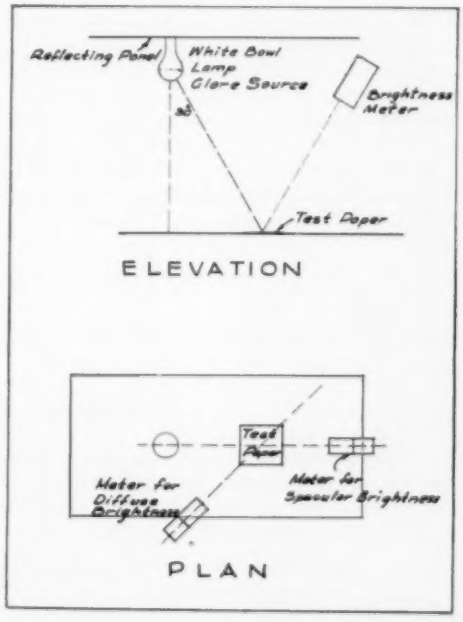


Figure 1. Elevation and plan view of experimental set-up for investigative procedure.

Authors: Consulting Engineer, 82 Smallwood Drive, Snyder 21, N. Y., and Illuminating Engineer, Niagara Mohawk Power Corp., Buffalo 3, N. Y., respectively.

inked bar was first observed. The paper was then shifted to one side (to avoid changing the position of the Luckiesh-Taylor meter) and readings taken of the paper. Two observers took all the readings on one day. On another day readings were repeated by a different team. All readings were then grouped and averaged.

After the calculations for reflectances had been completed, the experimental setup was altered. The same glare source (500-watt white bowl lamp) was suspended in a black room with no reflecting board. This greatly lowered the diffuse component without altering the specular componenn. Reflectances determined under these conditions were the same as found by the previous method.

The horizontal footcandles were determined by measuring the brightness of a block of magnesium carbonate. The brightness of the glare source was determined by direct measurement.

The specular reflection factor is the ratio of brightness of reflected image over brightness of glare source. The brightness of the reflected image is found by subtracting the value of the diffused brightness from the readings of Meter No. 1. The diffuse reflection factor is the ratio of brightness of surface over footcandles on the surface.

Results

The specular and diffuse reflectances are listed in Table I. The 24 papers examined represent a good sampling of the papers used in books, magazines, newspapers and clerical work. Insofar as possible the specimens are identified by manufacturer and trade name. By this means comparisons can be made with other papers by those familiar with the paper and printing industries.

TABLE I.—Reflectances of Papers and Ink Determined Under Tungsten Light.

Specular measurements made at 30°-45° from vertical.

	Dull Papers	Specular Paper	Specular Ink	Diffuse Paper	Diffuse Ink
1.	Newsprint	.0034	.0023	.66	.047
2.	16 lb Sulphate Bond	.0026	.0022	.63	.042
3.	25 lb Rag	.0020	.0026	.72	.035
4.	70 lb Offset	.0014	.0019	.73	.044
5.	20 lb Hammermill	.0014	.0020	.71	.040
6.	Canary Sulphate	.0026	.0035	.65	.039
7.	24 lb 75% Rag	.0010	.0054	.76	.023
8.	Warren Printone 60 lb letterpress	.0024	.0057	.75	.025
9.	Warren Silkote 60 lb Offset	.0021	.0041	.75	.030
10.	Warren Cumberland 50 lb	.0017	.0026	.80	.040
11.	Oxford 50 lb	.0015	.0019	.77	.036
12.	Hopper 60 lb Offset	.0027	.0045	.78	.027
	Satin Finish & Semi-Gloss				
13.	80 lb Gloss	.0042	.0054	.78	.028
14.	50 lb Semi-Gloss	.0023	.0044	.73	.040
15.	Oxford Polar Superfine 70 lb	.0079	.0093	.80	.018
16.	Oxford Publication Text 50 lb	.0037	.0071	.75	.023
17.	Oxford Engravatone 55 lb	.0051	.0080	.74	.013
18.	Consolidated 50 lb	.0056	.0063	.78	.019
19.	60 lb Semi-Gloss	.0062	.0080	.78	.020
20.	St. Regis Flash Gloss	.0070	.0105	.76	.019
21.	N. Y. & Penna. 50 lb Super	.0056	.0093	.77	.023
22.	Consolidated Merrill 40 lb	.0051	.0130	.75	.019
	High Gloss				
23.	Warrens 70 lb Lustro-Gloss	.0160	.0095	.80	.018
24.	Warrens Lusterkote	.0152	.0106	.80	.019

No attempt should be made to correlate the data or look for any consistency of results. The relationship between the nature of printing ink and the paper it is applied to is very complex. While upon inspection all of the inks could be said to be "dull," yet there is more than a 2 to 1 variation in diffuse reflectance, and a 5 to 1 variation in specular reflectance.

The authors are indebted to Mr. George Adams, printer, and the Franklin-Cowan Paper Co., both of Buffalo, for their cooperation in selecting, furnishing and printing the samples.

Membership Directory Available

An accurate up-to-date business directory of the entire membership of the Illuminating Engineering Society has been compiled under the direction of the Publications Committee, and is now available from Society Headquarters. Copies of the directory, 6 x 9 inches in size, may be obtained at $2.00 for single copies, or $1.75 each for quantities of ten or more.

Orders should be addressed to the Illuminating Engineering Society, Publications Office, 1860 Broadway, New York 23, N. Y.

Lighting for color photography in motion pictures demands special equipment such as the 50-kw lighting unit shown at right. The 50-kw lamp, reflector and the Fresnel lens make up this optical system.

Photograph courtesy of Lamp Division of General Electric Company.

Lighting Requirements of a New Professional Color Film for Motion Pictures

By RICHARD BLOUNT

LIGHTING for 35mm color motion pictures has in the past been very demanding of light sources. The color film used almost exclusively was balanced to "daylight" and the illumination required for basic exposure was of the order of 500-600 footcandles. These requirements were satisfied with little color modification by certain of the flame arc carbons, but since the tungsten used for lamp filaments melts at 3550°K, it was obviously necessary, when using filament lamps, to employ a filter at the light source to correct its color to the required "daylight" quality.

The filament color temperature chosen about 17 years ago for this purpose was 3350°K, making possible lamp designs from 5-kw at 75 hours life to 500-watts and 8 hours life. These lamps, when used in conjunction with a standard filter, met the "daylight" requirements of the film. Because the filter absorbed about 60 per cent of the available light, the use of this combination of lamp and filter has been somewhat limited in the motion picture studios. Carbon arcs, with only moderate filter correction, have supplied a much greater portion of the light used for such color photography.

In 1950, Technicolor announced a new color film which is balanced to the color quality of the tungsten filament lamps. In addition, the sensitivity of the new film is increased markedly—now requiring only 75-100 footcandles for proper exposure. The introduction of this new color film has resulted in a marked increase in the use of filament lamps for color photography and practice now indicates that 2-kw lamps will become the "work horse" of the studios.

A limited number of pictures are now being made with the new color film, one of which is

Author: Lamp Division, General Electric Company, Nela Park, Cleveland, Ohio.

Paramount's "The Greatest Show on Earth," made by Cecil B. DeMille in conjunction with Ringling Brothers and Barnum and Bailey Circus. The motion picture company spent a number of months with the Circus at their winter quarters at Sarasota Florida, and, to portray the circus on the road, they rejoined it on tour at Washington, D. C. and Philadelphia.

Lighting for color photography in the Big Top on the road and at Sarasota was accomplished by especially designed Fresnel-lens fixtures and 5-kw 3350°K filament lamps. The equipments are noteworthy because they can be remotely aimed and the light distribution adjusted from spot to flood. With all the control motors the fixtures have less than half the weight of earlier equipment. Due to an improved cooling system, bulb temperatures were also reduced. These improved lighting facilities, developed by Paramount engineers, aided the movie company in finishing their location shots well ahead of schedule.

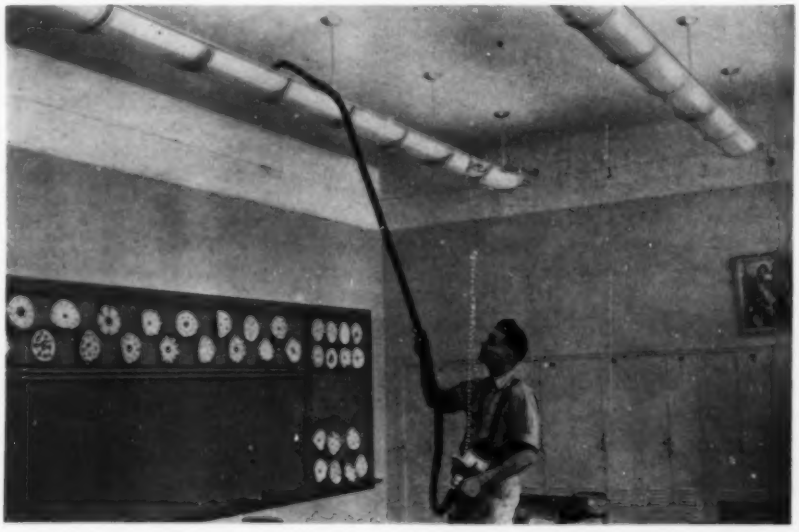
One of the final location shots shows the preparations for the dropping of the Big Tent at the close of the stand in Philadelphia. These pictures taken after dark required extensive lighting facilities. These included two 50-kw as well as a number of 10-kw filament lamps and some 225 ampere arcs, all in Fresnel-lens fixtures. The 50-kw housings were made up by Paramount and incorporated a special lamp socket and ventilating blower but necessarily utilized optical elements designed for smaller sources. Since the cold resistance of a 50-kw filament is approximately 0.040 ohms, a series resistor was used during the initial warm-up, limiting the current to less than 500 amperes. The two 50-kw lamps were located near the end of the tent and above contributed about 75 footcandles 200 feet away over a fairly wide area.

Ingenious Device Simplifies Maintenance

Between semi-annual washings, the luminous indirect lighting equipment in the Vermilion Ohio high school is kept dust-free with an ingenious device. Put together by the custodian of the high school, the device consists of an old vacuum cleaner, a tube, hose and hook—cost: six dollars. Blowing the dust out of the equipment takes about ten minutes to a room, including the plugging-in and disconnecting.

In this type of lighting equipment, where 90 per cent of the light is thrown to the white ceiling and only 10 per cent comes through the luminous plastic shield, the light loss from dust on the shield is relatively small. But dust does collect on the top of fluorescent tubes where it can easily be removed by the vacuum cleaner device.

Photo courtesy F. W. Wakefield Brass Co.



Lighting an Underpass

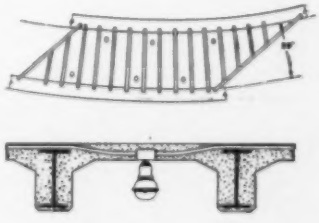
LIGHTING OBJECTIVE: To light a relatively short, curved underpass with the same type lighting equipment used on the approach roadways.

Installation at Hunting Park - Ridge Avenue Underpass, Philadelphia, Penna.

General Information: The underpass is approximately 110 feet long constructed on a curve so that the walls form a background similar to the problems encountered in a tunnel. The roadway consists of two 12-foot lanes separated by a 2-foot medial strip. It is bordered by very narrow sidewalks approximately 18 inches wide. The ceiling is constructed with beams approximately 28 inches deep running crosswise to the roadway, providing a roadway clearance of 14 feet. The walls and ceiling are natural concrete with a reflectance of the order of 30 per cent.

Lighting Installation: Six Westinghouse OV-20 luminaires using E-H1, 20,000-lumen mercury vapor lamps are installed in a staggered arrangement so positioned relative to the beams that glare is almost completely eliminated. The electrical distribution system is multiple. The 115/220 volt ballasts are located in receptacles in the walls of the structure. All wiring is in metal conduit concealed in the concrete.

The average footcandle value on the roadway after six months operation was measured at 6.9 footcandles. The average vertical illumination on the sidewalls (5 feet above the sidewalk) was measured at 4.1 footcandles, providing a ratio of brightness values in the visual range of a motorist of less than 2 to 1. This installation illustrates that a radical departure from conventional mounting height and spacing ratios for given lamp sizes may be tolerated if direct glare can be avoided and if acceptable brightness ratios are maintained.



Lighting data submitted by H. E. Mason, Bureau of Lighting and Gas, Philadelphia, as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society
1860 Broadway, New York 23, N. Y.

A.I.A. File No. 31

Figure 1. View of the ski slope as it was illuminated.

Night Skiing on Floodlighted Slopes

By D. R. BROWN

The installation for floodlighting a winter ski slope was an entry in the contest for "My Most Interesting Lighting Installation," conducted by the Central New York Section, I.E.S. taking second prize.

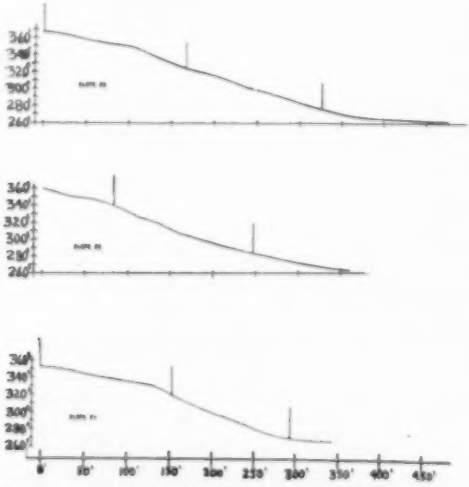


Figure 2. Three elevated sections of the hillside showing slope along the three pole lines.

THE MANAGEMENT of Drumlins Golf and Sports Center, Syracuse, N. Y., was often requested to allow skiing on the slopes of their sports areas on moonlight nights. Fear of accidents due to inadequate light always prompted a refusal until the decision was made to illuminate the ski slope.

To study the problem, a topographical map was made, on which the area to be used was designated. All permanent structures, such as towers or poles, were restricted to this area, because in other seasons the slope is used for other sports.

Fig. 2 shows three elevated sections of the slope along the pole lines as taken from the topographical map. The three cross-sections of the slope indicate the variation in the length of the ski runs and also the uniformity in the vertical rise of the area. The poles are spotted on the slopes to give an idea of elevation at each location and the average distance of 170 feet between poles.

After consulting authorized sources as to recommended levels of illumination for practice slopes, Drumlins management and the illuminating engineers decided to double the minimum specified. The I.E.S. Lighting Handbook (First Edition) specifies an average of 0.5 footcandle for practice slopes.

Author: Crouse-Hinds Company, Syracuse, N. Y.

Figure 3. Snow fence at bottom and top of tow line prevents congestion and crowding with possibility of accident.

N.E.M.A. sets up 0.03 watt per square foot—which amounts to the same thing in different terms.

The outside pole lines (which also serve as part of the facilities for the two tow lines) encompass an area approximately 400 by 500 feet. Using a multiplier of 0.06 watt per square foot — double the N.E.M.A. minimum —2a total of 12,000 watts is required for good illumination. This is approximately 16 floodlights of the 500-watt and 1000-watt variety with a ratio of two watts in the direction of travel to one in the opposite direction. The recommended distance between floodlight locations across the slope should not exceed 300 feet if shadows of the skiers are to be minimized. Therefore, the pole lines were placed 250 feet apart, with the two poles in the center line staggered with relation to those in the two outside lines. The three poles in each tow line and the two in the center line provide eight locations for floodlights.

The arrangement of lights used ten 1000-watt and eight 500-watt luminaires to total 14,000 watts. This, then, provides 0.07 watt per square foot or more than double the N.E.M.A.-specified minimum. The illumination readings shown in Fig. 4 (taken when the slope was covered by two to three feet of snow) are fairly uniform, averaging about one footcandle, or twice the I.E.S. Handbook Specification. Mounting height of luminaires was 30 feet, about twice the minimum recommended (1/10 the distance between pole locations).

Most of the floodlights were of the general service type, both 1000-watt and 500-watt, with wide beam etched Alzak reflectors. The 1000-watt type provides 10,038 beam lumen output within a beam spread of 110°. The 500-watt luminaire provides 5268 beam lumens within a spread of 106°. Some heavy-duty 1000-watt lights, which the owner had on hand, were interspersed with the others. The lenses on these were changed to 50° spread to provide a beam pattern similar to that of the general service floodlights and prevent spottiness in the overall effect.

In addition to the main slope, the area beyond is illuminated, although not to the same degree. There is one 500-watt floodlight with diffused lens provided at each end of the tow lines, placed to illuminate the entrances and exits for safety purposes. Diffusing lenses were used to prevent lamp filament glare, which could confuse patrons using the tows. The operator of the tow, at the bottom of the slope, must be able to see the skiers leaving the tow at the upper end. Although there is a safety arrangement to prevent skiers from being entangled in the end pulleys, the operator should be able to note any unusual activity at this point.

A general aiming chart was provided for daytime aiming, but on-the-spot night aiming was necessary after because the terrain does not have uniform slope. Re-aiming eliminated the worst of the shadows in low spots and hollows. The slight shadows which remained in depressions have been found helpful in controlling skiing since they indicate sudden differences in slope, and the overall illumination is adequate.

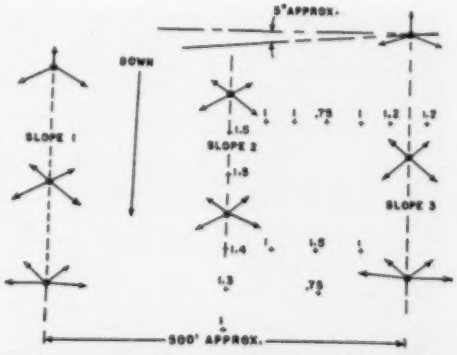


Figure 4. Illumination readings taken when the slope was covered by two to three feet of snow.

Floodlighting a Quarter-mile Auto Race Track

By R. H. GOODMAN

This installation of a stock-car race track won first place in the contest conducted by the Central New York Section for "My Most Interesting Lighting Installation."

THIS is the story of how a one-quarter-mile midget auto and stock car race track was floodlighted. The track is the Brewerton Speedway, Brewerton, New York — a small town in central New York State. The floodlighting of this track quite logically is divided into 3 sections, the Problem, the Solution, and the Results.

The Problem

There is no "standard" layout for race tracks such as you will find for baseball, football, etc., in the NEMA layouts. In Appendix "A" in the IES Lighting Handbook (first edition) we do find, however, that for an auto race track we should have 20 footcandles. Our problem then was to design the lighting system to produce 20 ft-c or as near to it as possible, in view of limited funds, and still remain consistent with good lighting practice.

Mr. Goodman is an Application Engineer in the Illumination Dept. of Crouse-Hinds Co., Syracuse, N. Y.

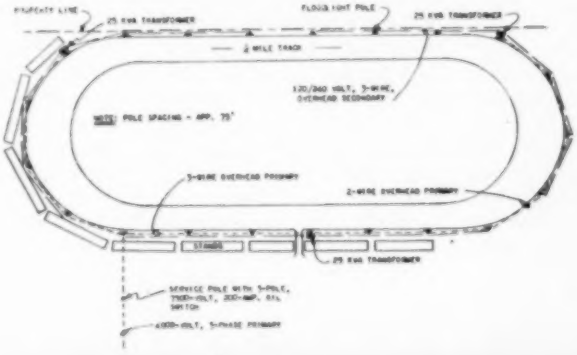


Figure 1. (Left) The 4800-volt, 3-phase primary service feeds in to service entrance pole where oil switch controls the complete installation.

Figure 2. From the last turn, the starting line can be seen across the track. Service entrance pole is in background to the right.

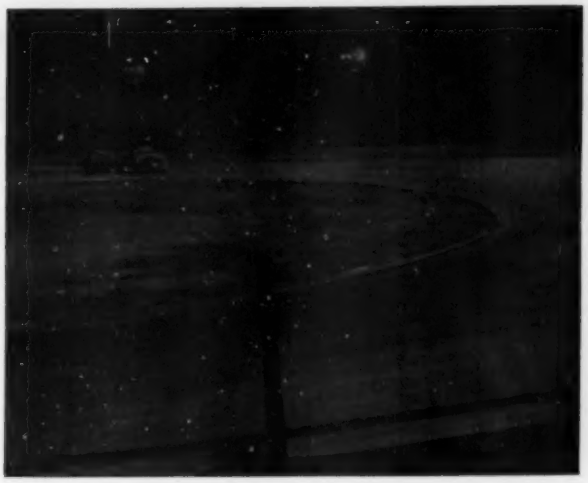


Figure 3. Attendance on opening night was over 5000 racing fans who watched the races under an average of 15.4 ft-c. over the track.

The Solution

Our first step was the selection of floodlighting equipment. We used a general purpose type floodlight quite widely used for sports lighting, which has an Alzak aluminum reflector, cast aluminum socket housing and accommodates a 1500-watt lamp.

The next step was to consider possible pole locations. We had three possibilities — in front of the stands, at the back of the present stands which were being extended, or at the back of the extension. Due to shorter poles and other factors, it was found that the locations in front of the stands would be the most economical. A 30-foot mounting height which is consistent with other sports lighting layouts was decided upon. To hold the spacing to no more than 2½ times the mounting height, the poles were spaced 75 feet apart. This spacing gave us a total of 21 poles. Then with mounting height and pole locations established, it became possible to actually plot a beam pattern of a floodlight on the track to determine just how much light we were getting.

From our calculations, we found that three units per pole were necessary to provide adequate coverage and maintain an acceptable uniformity of illumination. These calculations also showed exactly where each floodlight should be directed.

Most of the light is directed toward the direction of the race to further reduce the possibility of objectionable glare to the drivers. Thus we found that the third unit on each pole — the one directed furthest down the track — should have a slightly narrower beam spread.

With three floodlights per pole and each using a 1500-watt, 115-volt, PS-52 clear bulb, general lighting service lamp operated at 10 per cent above rated voltage (common practice in sports lighting), we expected to get approximately 15 footcandles average over the track. This was considered very good since many similar tracks have perhaps no more than 5 to 10 footcandles.

With the number and location of floodlights established, the next step was the wiring system. Fig. 1 shows the 4800-volt, 3 phase primary service feeding in to the service entrance pole. At this point, we have a 3-pole oil switch to control the complete installation. The primary then runs to a floodlight pole and then to the three transformers. Each transformer feeds seven of the 21 poles. All wiring is overhead and the secondary is 3-wire, 120/240 volts.

Results

With the installation completed, we come to perhaps the most important part of the job — *What are the Results?* When the main oil switch was thrown, we saw what we had accomplished. Fig. 2. Here we are almost into the last turn looking across the track toward the starting line. The service entrance pole is in the background to the right.

In the Fig. 3, we move farther into the last turn and see a little more clearly the service entrance pole. This was opening night and the attendance was between 5000 and 5500.

A series of footcandle readings were taken and the average was found to be 15.4 footcandles over the track.

Modern Approach to Lighting Gasoline Service Stations

By HOWARD KETCHAM

AMERICA'S service stations have come a long way since the era when gasoline was drawn into a measure from a drum in the back room of a store and funneled into the automobile tank. Forty billion gallons of gasoline are pumped into motor vehicle tanks annually, and operators of the nation's 188,000 stations have become one of the most competitive groups of retailers in the country.

Eye-catching stations now cost as much as $100,000, and new sources of revenue are constantly sought to provide a return on such sizable investments. For example, one station in Stratford, Connecticut, makes keys. The service station operator is no longer an attendant or mechanic, but a merchandising man who depends on sale of accessories and services for 40 per cent of his gross profit. For every 1000 gallons of gasoline sold, a profit of $75 from other items is considered standard, by dealers affiliated with one major company.

The problem is to bring patrons — old and new — into the station, and to employ the attraction of a well-lighted display window effectively to take advantage of the three minutes a motorist spends parked beside the pump. Surveys have shown that 28 per cent of service station patronage is at night — yet for the most part some of the most pressing requirements of station lighting are seldom met.

Basic considerations in service station lighting are these:

A. Overall lighting level that sets off the station from its surroundings, and makes it more highly visible to the fast-approaching motorist.

B. Accent lighting that dramatically highlights the focal point of sale — the pumps.

C. Color correction in the light-source, to show without distortion the colors of station, pumps and signs — improving brand recognition, so that the motorist loyal to the brand does not find himself past the station before pulling up.

D. Protection of the motorist's eyes from direct-vision glare — a major safety factor.

E. Even spread of light, avoiding the "spotty" patches of adjacent brightness and shadow which make some of our most costly stations appear tawdry.

F. Saving of current, and spotlighting the station, by confining the illumination within the property line.

For years, service stations have employed lighting techniques which have defeated these objectives. Few service stations have created the impression of standing out from their surroundings. High-mounted fixtures over the pumps spread the light

Author: President, Howard Ketcham Inc., New York, N. Y.

TABLE I.—Lighting Levels Desirable in Service Stations.

	Footcandles
Station Driveway, Height 3' 6"	18–20
Station Driveway, Ground Level	8–10
Station Structure, Height 6' 6"	6
On Pump Island, Height 3' 6"	30
On Pump Island, at Base	15–17
Display Window, Height 3' 6"	18
General Average, Sales Room Interior, Height 3' 6"	25
Rest Room, Before Mirror	15
Rest Room, Average	8–10
Lubritorium, Down-Lighting over Repair Area	20–25
Lubritorium, General Average at 3' 6"	12–15

TABLE II.—Classifying Stations.

Group 1 — Well-lighted highway	1000–2000 cars
Group 2 — Medium lighting nearby	400–1000 cars
Group 3 — Poor lighting nearby	50–400 cars
Cars per hour, average 5 P.M. - 5 A.M.	

TABLE III.

Classification Group	General Station Lighting*	Accent Lighting for Pump Islands*
1	20 Footcandles	30 Footcandles
2	15 "	25 "
3	10 "	15 "

*at 3' 6" above ground level.

TABLE IV.—Window Display Lighting: Pump Island Over 20 Feet From Building*

Group	Impulse Buying Encouraged	Planned Purchasing Only	Attendants as Sales Force	Impulse & Planned Purchases
1	80 ft-c	45 ft-c	40 ft-c	55 ft-c
2	60 "	35 "	32 "	45 "
3	28 "	16 "	15 "	28 "

*at 3' 6" above ground level.

TABLE V.

Group	Station Emblem Sign*	Building Front Area
1	200 ft-c	6 ft-c
2	150 "	4 "
3	100 "	2 "

*at sign level.

outward, in an effort to provide some visibility for the apron — and leave the sides of the pump in shadow. The attractive blue which various companies feature in their station color stylings is almost always an unrecognized and undistinguished black under night lighting. Familiar lighting fixtures — particularly the vertical units growing in favor during the past few years — blind the motorist.

In my work as consultant for three major oil companies, I have had occasion to test hundreds of stations, checking lighting levels at all points on the station property with light-meters, getting readings at varied heights from ground level up. From these studies I have evolved, for my own practice, lighting levels which provide a rule-of-thumb for practical but effective lighting. The set of tables which accompanies this article does not pretend to reach an impossible ideal. Rather, it points to the practical and attainable, to make a station attractive to new patrons.

It has been my experience in planning lighting of service stations that the station which stands out at night, properly illuminated and showing the company's colors without distortion, attracts as much additional daytime business as night patronage. The prestige and good impression that a station obtains from proper night lighting carries over into day patronage.

Table I shows some of the attainable lighting levels for different areas of the station, at different heights from the ground. However, the proper level of illumination is based on several factors — the lighting of nearby areas outside the station, and the volume of traffic and illumination which is prevalent on the highway. Generally, there is a close relationship between these points. Table II sets up three classifications of station lighting, relating each group to the highway lighting and night traffic. The lighting levels in Tables III, IV and V are keyed in each case to the needs of each group.

A black button is visible against a white card under lighting of a single footcandle, but requires 1000 footcandles to show up against a black card, at the same distance. Service station lighting is based on the same principle.

For instance, the desirable level of general station lighting and the accent lighting on the pump are greatest on well-lighted highways with heavy traffic. A distinct impression, visible from a distance, with ready recognition, is the objective to attract the loyal-to-the-brand motorist or the new patron.

To protect the motorist from the blinding effect caused by spotty lighting or glare within the station, resulting from too great a contrast in the illumination levels of adjacent areas, an even "flow" of lighting is necessary. Brightness ratios of 15:1 or more cause visual discomfort. Recommendations in Table III hold the accent lighting on pumps far closer to the general station lighting figure. At the same time, glare-free light-sources out of the line of direct vision of the driver are imperative to avoid mishaps as he pulls up alongside the pump island.

Figure 1. Horizontal service-station pump-island lighting device employs cold-cathode fluorescent lamps, using T12 4500-degree white 430 milliamp tube.

The interior lighting of the station display window, as shown in Table IV, will be even higher if the station operator seeks the profit-building trade offered in sale of accessories — known in the industry as TBA, or Tires, Batteries and Accessories. Two or three low-cost swivel-socket fixtures, mounted on the inside wall above the window, and employing 150-watt floodlight lamps, can create 50 to 60 footcandles of lighting, with directional control of the light-splay.

There is increasing recognition of the worth of effective window display, with lighting and display

treatment to get the best value out of the station window.

Several major companies provide standard window displays for operators, charging a nominal fee as a contribution toward cost of materials. A few stations call in department-store window-trimmers once a month.

The average station window is about 25 feet from the pump island. An effective window display, properly lighted and presenting the merchandise appearingly, can mean more profit than the sale of gasoline itself. A good merchandising display thus makes it worth while to turn on window lighting during the day, to overcome daylight reflections which "conceal" the display. A study by the New York University School of Retailing proved that well-displayed items continue at a higher rate of sales even after removal from the window.

The powerful lighting on the station emblem sign, as shown in Table V, reflects a growing emphasis on the sign as a trade-builder. The Point-of-Purchase Advertising Institute recently reported a trend toward larger signs, and one company has come out with a sign lighted from within.

Modern approaches to station lighting offer new hope for achieving light-level and light-quality objectives. A 40 per cent increase in sales was reported by a Deep Rock Oil Corporation station in Tulsa, Oklahoma, the first month after it introduced a specially-designed lighting device. (See Fig. 1.) With this unit, cold cathode fluorescent lighting was used, one of the earliest uses of this source out of doors. In this device, the light-splay is downward and outward through the open bottom, which is louvered at an angle to control the even spread of illumination. The louver is hinged, for ready maintenance. Brackets over the louver allow the insertion in cold weather of removable double-strength crystal glass panels. All-weather effectiveness is further assured with heat-lamp units, switch-operated manually by the station operator. Floodlights attached to the top of the unit, permitting use of spots or floods to beam on the station structure, are in waterproof housing and swivel 360 degrees on the horizontal and 70 degrees on the vertical.

This lighting device raised the illumination reading on the apron around the pump island from 1.51 to 12.75 footcandles.

New lighting techniques are not the only change which will make tomorrow's station a brighter, glowing sales-builder. Luminescent paints, heretofore a novelty, can serve a practical, functional role in merchandising with the development of more durability and lower cost. Station visibility, distinctiveness, and eye-catching power will be improved. One of these days the old phrase about "painting with light" may be reversed to read "lighting with paint."

1951 National Technical Conference Papers

Preprints of the technical papers on important lighting subjects which will be presented before the I.E.S. National Technical Conference being held in Washington, D. C., August 27-30, will be on sale at the Registration Desk at the Conference or may be mailed direct from Headquarters during the week of August 20, upon request.

Price for the set, if picked up at the Conference Registration Desk, Shoreham Hotel, is $1; if mailed from the Conference or from Headquarters in advance of Conference, $1.50.

Readers who wish this important lighting data but who may not be able to attend the Conference should place orders for Conference Preprints now, since in all probability some of the papers will not be published in ILLUMINATING ENGINEERING. Send orders to Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

I.E.S. Guide for Outdoor Illumination Tests

Prepared by the Committee on Testing Procedures for Illumination Characteristics of the Illuminating Engineering Society*

Foreword

This report was developed in 1948 and 1949 by the I.E.S. Testing Procedures Committee to fill a need experienced by engineers doing field testing. It was presented to Council in June 1949, approved in March 1950 and then revised slightly to meet objections raised by the I.E.S. Sports and Recreational Area Lighting Committee and the N.E.M.A. Floodlighting Technical Committee. Liaison was also maintained with the I.E.S. Street and Highway Lighting Committee during the preparation of this material.

COMMITTEE ON TESTING PROCEDURES FOR ILLUMINATION CHARACTERISTICS

G. A. Horton, *Chairman (1950-1951)*
R. P. Teele, *Chairman (1949-1950)*

A. C. Barr	G. E. Korten
E. W. Beggs	A. E. Krawcek
J. E. Bock	A. P. Larson
R. D. Bradley	W. F. Little
E. H. Church	D. L. Markle
D. M. Finch	J. H. McCulloch
Kurt Franck	Phelps Meaker
S. M. Gray	F. M. Neal
B. F. Greene	D. W. Rowten
Rudolph Hultgren	R. L. Smythe
	A. W. Weeks

1. General

1.1—*Objective*—To provide a guide that will promote uniform test results in determining and reporting the illumination characteristics of outdoor lighting installations.

1.2—*Quantities Measured*—The illumination characteristics are described in terms of *illumination* in *footcandles* from luminaires at specified mounting heights and spacing arrangements. The illumination on a horizontal plane is always measured, and in some installations measurements on various vertical planes may be needed in addition.

1.3—*Conditions of Test*—(a) The test stations should be located so that the test results represent the effective illumination. Suggested test-station locations for typical street lighting illumination tests are given in Figs. 1 and 2; for baseball fields in Figs. 3 and 4; and for football fields in Figs. 5 and 6.

(b) If the test is made for the purpose of checking the performance of the installation after depreciation in service, the condition of the luminaires and lamps should be noted; the number of hours the lamps have burned and the current, voltage or wattage supplied to the individual lamps should be determined or estimated. Otherwise, the luminaires should be cleaned, new lamps (preferably seasoned* and rated) installed, and both lamps and luminaires properly adjusted. If improvement due to cleaning and maintenance is to be determined, measurements should be made both before and after cleaning.

(c) Discharge lamps should be operated for at least a half-hour to reach normal operating temperature before measurements are made.

(d) Tests should be made when the atmosphere is clear, during the dark of the moon, and when extraneous light is at a minimum. Suggestions for making tests when these conditions can not be realized are contained in Appendix A.

1.4—*Test Equipment*

1.4.1—*Test Surface*—Regardless of whether the photometer is of the visual or photoelectric type, the test surface should be accurately leveled.[7, 11] For accurate results a test plate or photoelectric cell compensated for departures from the cosine law must be used.[2, 4, 8, 9, 10, 11]

1.4.2—*Use of Filters*—If a visual photometer is used, any existing color differences should be minimized by filters, and proper allowances made for their absorption. This is especially important where the illumination to be measured is from mercury and sodium vapor lamps. When possible it is best to calibrate visual photometers with neutral range-changing filters in place. Where photoelectric photometers are used, correction may be made with color filters so that the spectral response of the system follows the I.C.I. luminosity curve within practicable limits. The proper multiplying factors for use with uncorrected cells may be obtained from the photometer manufacturer but for maximum accuracy should be determined by separate laboratory test on the particular cell employed.

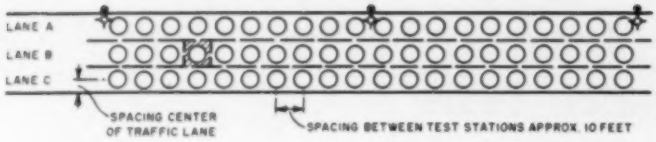
1.4.3—*Electrical Instruments*—All instruments should have good reproducibility of indication and large scale deflections for the values that are to be read.

1.4.4—*Photometers*—Visual photometers[5] with a split field are preferable to those with a concentric field. (See Appendix A.)

1.5—*Test Procedure*—Use a recently calibrated photometer and in the case of visual photometers check the comparison lamp current (or voltage) at each reading station throughout the test (see Appendix A). Several readings should be taken at each station and the average recorded. Repeat readings at the first test station at the middle and end of the test. Photoelec-

*Approved by the I.E.S. Council, March 1950.

*A seasoning schedule is given in Appendix B. A *rule of thumb* is to burn incandescent filament lamps at rated voltage or current for 2 to 3 per cent of rated life, and discharge lamps for 200 hours.



INSTALLATION DATA

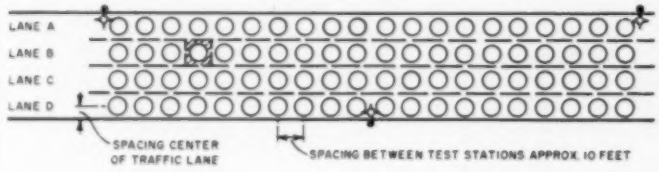
Average of reading stations .....
Minimum value .....
Maximum value .....
Ratio of minimum to average .....
Ratio of maximum to average .....

Street classification .....
Type of pavement .....
Reflectance ..... (optional)
Luminaire type .....
Light source .....
Electrical and operating conditions:

Mounting height .....
Spacing .....
Environment:

Test plate leveled at not more than 6 inches above the roadway surface.
Test plate compensated for departure from cosine law.

Figure 1. Locations of test stations for illumination measurements on streets and highways: (a) luminaires located on one side of roadway; (b) luminaires located in staggered arrangement (on alternate sides of the roadway); (c) luminaires located in opposite arrangement (on both sides of roadway). Crosshatching indicates typical rectangular test area at the center of which illumination reading is taken.



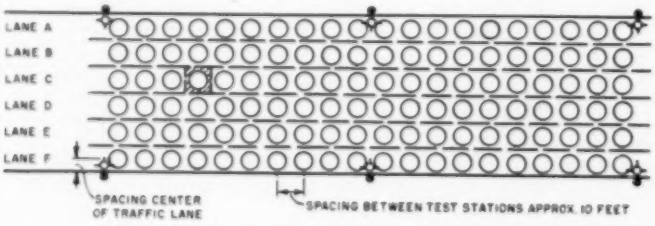
INSTALLATION DATA

Average of reading stations .....
Minimum value .....
Maximum value .....
Ratio of minimum to average .....
Ratio of maximum to average .....

Street classification .....
Type of pavement .....
Reflectance ..... (optional)
Luminaire type .....
Light source .....
Electrical and operating conditions:

Mounting height .....
Spacing .....
Environment:

Test plate leveled at not more than 6 inches above the roadway surface.
Test plate compensated for departure from cosine law.



INSTALLATION DATA

Average of reading stations .....
Minimum value .....
Maximum value .....
Ratio of minimum to average .....
Ratio of maximum to average .....

Street classification .....
Type of pavement .....
Reflectance ..... (optional)
Luminaire type .....
Light source .....
Electrical and operating conditions:

Mounting height .....
Spacing .....
Environment:

Test plate leveled at not more than 6 inches above the roadway surface.
Test plate compensated for departure from cosine law.

tric photometer readings should be reproducible within 5 per cent; visual photometer readings within 10 per cent. Keep the electrical operating conditions of the lighting equipment as near to rated values as possible throughout the test.

1.6—*Test Report* — The test report should present the significant data in a manner that will permit further derivation of useful information. It is recommended that the items listed below be included.

1.6.1—*Description of Installation and Conditions*

(1) Location (city, street and section thereof, sports field, date, etc.).
(2) Description of lamps, luminaires, floodlights or projectors.
(3) Mounting height, spacing and arrangement. (For street and highway lighting include overhang and in the case of steep hills or streets record the grade. If foliage interferes with the illumination at any test station, so note and give an estimate of the extent of such interference.)
(4) Diagram showing test stations.
(5) Electrical operating conditions.
(6) Condition of luminaires and other accessories.
(7) Describe environment, particularly any extraneous light sources which could not be controlled, weather and sky conditions, location and reflectance of buildings influencing lighting.

1.6.2—*Photometric Data*

(1) Tabulation of test data.
(2) Tabulation of special measurements taken.

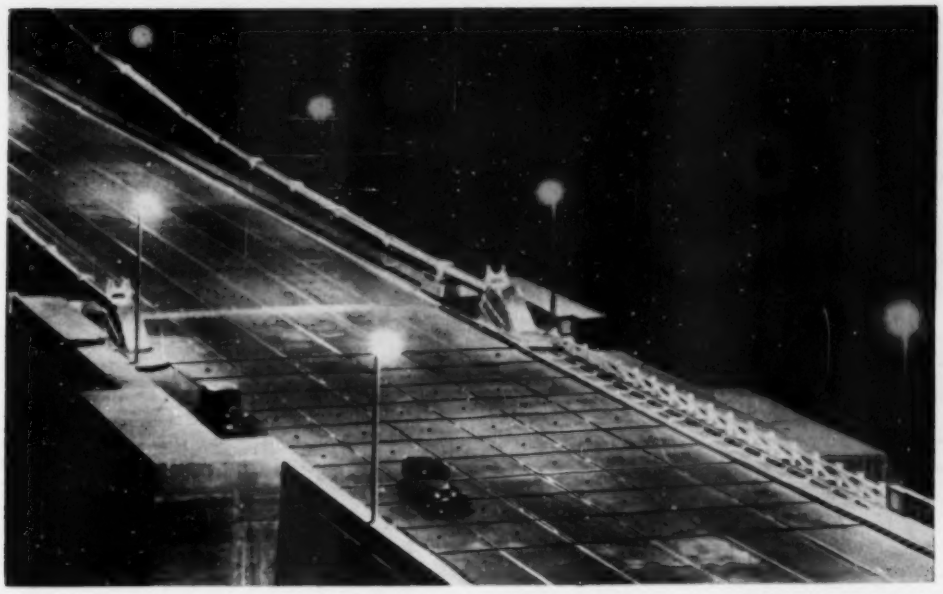


Figure 2. Six-lane highway bridge with test stations plotted on the surface for one span. Readings should be taken for two spans as indicated in Figure 1c.

(3) For street lighting record the ratio of maximum and minimum to average horizontal illumination.
(4) Horizontal or vertical illumination. Record height of test plate above surface of street or field. For vertical illumination record orientation of test plate.
(5) Manufacturer's name and model of visual or photoelectric photometer used.

2. Location of Test Stations for Streets and Highways[6]

2.1—*General* — **(a)** Test stations should be systematically chosen in such manner as to represent correctly the illumination pattern.[1] The test span should be divided into an even number of equal rectangular test areas, the luminaires being over the intersection of boundary lines of such areas rather than over the centers of the areas. Footcandle readings are taken at centers of the test areas. The mean for the entire surface can be computed from the average horizontal illumination for test stations so disposed if sufficient number is selected. Enough stations should be chosen so that additional readings in similarly distributed locations will not change the average results significantly. The test plate should be not more than six inches above the street surface.

(b) Typical arrangements of street lighting luminaires and test stations are shown in Figs. 1 and 2. Fig. 1 shows typical survey charts. Fig. 2 is a photograph with test stations plotted on the surface.

(c) Only the readings taken at the basic test stations should be used in the calculation of the average values. However, other measurements may be taken at points of special significance, such as along the curb line and center line, half-way between or immediately under luminaires, or at points where a maximum or minimum intensity is anticipated. Where illumination on the sidewalks is important (as on residential streets) a row of test stations should be located along the sidewalk. Readings taken opposite each luminaire aid in plotting isolux curves and also give additional data where the illumination is changing most rapidly.

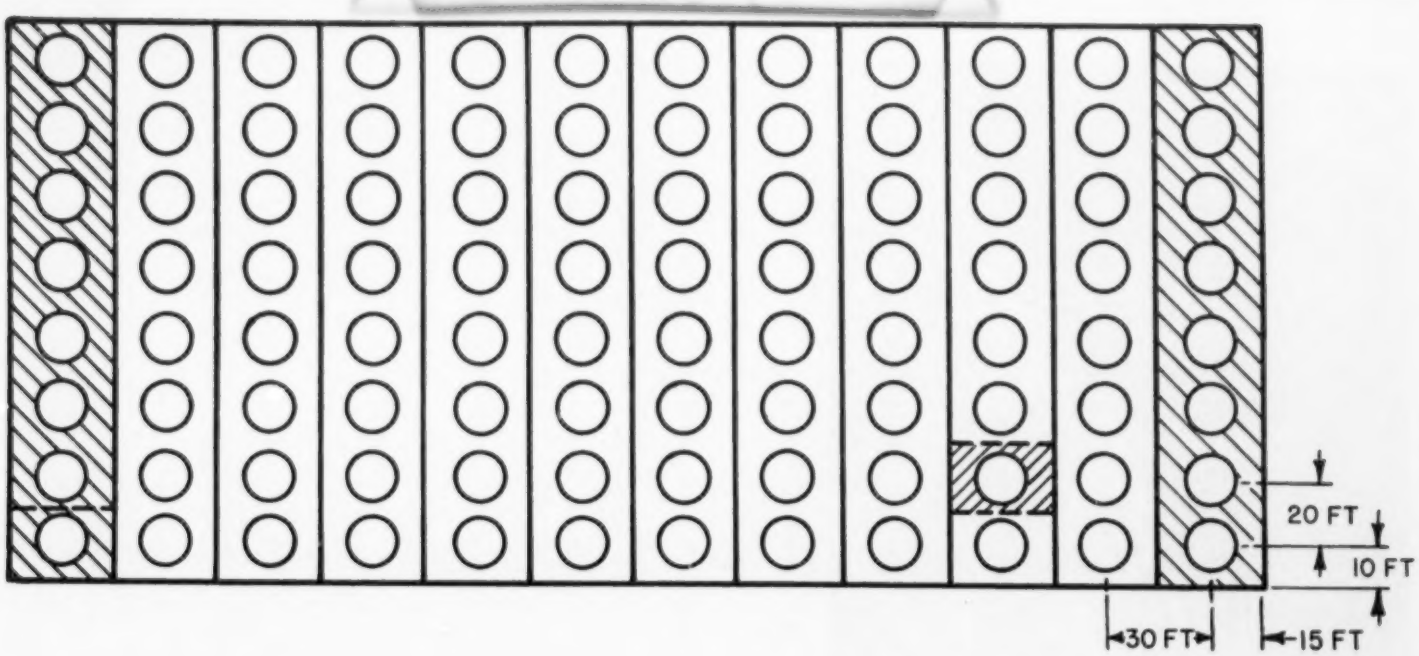
2.2—*Crosswise* — It is advisable to locate the stations in the centers of the traffic lanes. For this purpose, a traffic lane is considered to be approximately 10 feet wide. (For example, a 36-foot roadway is considered as 4 lanes.)

2.3—*Lengthwise* — Divide the distance between luminaires into an even number of divisions (approximately ten-foot intervals are suggested); take a reading in the middle of each rectangle thus formed.

3. Location of Test Stations for Football and Baseball Fields (and Other Sports Areas)

3.1—*Football* — Test areas 20 by 30 feet, having a reading station in the center of each rectangle, are suggested. See typical field survey chart Fig. 3, and photograph Fig. 4. The test plate height should be 36 inches.

3.2—*Baseball* — Readings should be taken at points representative of the whole area including a 30-foot strip outside of and paralleling the base lines, the complete area being divided into a checkerboard pattern of 30-foot squares with the reading stations in the center of each square. See typical field survey Chart Fig. 5 and photo-



Average of all readings _____
Minimum value _____
Maximum value _____
Ratio of maximum to minimum _____

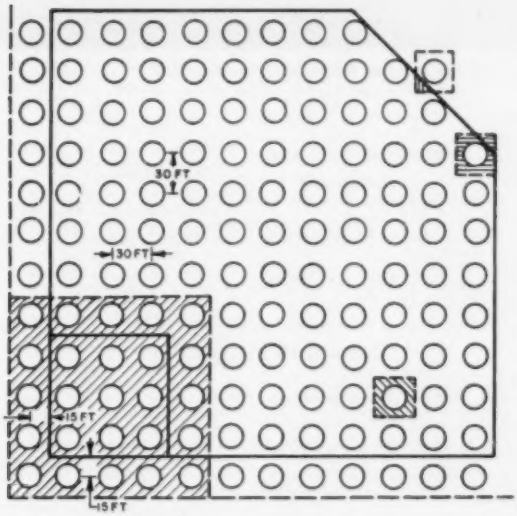
Test plate leveled at 36 inches above playing field.
Test plate compensated for departure from cosine law.

INSTALLATION DATA

Luminaire type _____
Number of units _____
Light source _____
Number of towers _____
Height of towers _____
Distance from tower to side line _____

Figure 3. Sample survey chart for measuring illumination on a football field. Crosshatching at ends indicates end zones; small crosshatched rectangle shows typical test area with reading station in center.

Figure 4. Locations of test stations plotted on football field.



FOR PORTIONS OF SQUARES GREATER THAN ONE-HALF THE AREA INCLUDE THE MEASUREMENTS (SEE SHADED AREA ▤).

FOR PORTIONS OF SQUARES LESS THAN ONE-HALF OMIT THE MEASUREMENTS (SEE SHADED AREA ▨).

INSTALLATION DATA

Average of 25 readings in infield	Luminaire type .....
Ratio of maximum to minimum	Number of units .....
	Light source .....
	Number of towers .....
Average of ..... readings in outfield	Height of towers .....
Ratio of maximum to minimum	Distance from tower to foul line .....

Test plate leveled at 36 inches above playing surface.
Test plate compensated for departure from cosine law.

Figure 5. Locations of test stations for illumination measurements on baseball fields. Crosshatched area in lower left indicates infield; small crosshatched area to the right represents typical 30-foot test square with reading station in center.

graph Fig. 6. The test plate height should be 36 inches.

3.2.1—Infield—The 25 test stations in the infield represent an area of 22,500 square feet. Additional photometric readings may be taken at home plate, at each base, and at the pitcher's box but are not to be included in calculating the average.

3.2.2—*Outfield*—The outfield area represents the balance of the playing area not included in the infield. This total area and number of test stations may vary because of differences in the depth of outfields.

3.3—***Other Sports Areas*** — Where special local lighting is not encountered, it is suggested that the squares or rectangles in which test stations are centered, be of an area not exceeding 5 per cent of the total area to be measured.

Appendix A
Suggestions, Precautions and Notes

The accuracy of field photometry is of a lower order than laboratory photometry due to the inherent inaccuracies of field tests and adverse test conditions encountered.

The characteristics of the battery operated lamps used in portable visual photometers are such that an error of one per cent in the current setting may make an error of as much as 10 per cent in the footcandle readings. See paragraph 1.5.

The response of the eye is not uniform over the retinal surface. A concentric field tends to give results that are influenced by this unevenness, whereas a split field tends to permit both halves to illuminate the retina symmetrically, thus giving a more accurate result. See paragraph 1.4.4.

Extraneous light, reflected from an overcast sky, or produced by a store, gas station, or other lights in the vicinity, requires careful attention in street lighting tests. Light from stores, etc., may be largely excluded by having an assistant stand where he will prevent such light from reaching the test surface. Measurements should not be made when snow is on the ground because the reflections would introduce appreciable errors.

The opposite condition occurs when the operator casts a shadow on the test plate and thus excludes some of the light from the equipment under test. The avoidance of shadows and exclusion of extraneous light requires alertness on the part of the test personnel.

Calibration — The photometer, with its own test plate, should be calibrated

Figure 6. Locations of test stations plotted on a baseball field.

against a standard light source. It should be checked by the operator taking the readings both before and after the field test.

Test Plate — The test plate should be kept clean and dry. When taking the illumination readings visually the angle of view should be kept within 30 degrees from a normal to the test plate. When measuring the illumination in a horizontal or vertical plane, care should be taken to orient the test plate correctly in the proper plane.

Test at Near Grazing Angles of Incidence — When testing street luminaires where the degree of illumination is of a low order and the angle of incidence large, it is particularly important that extreme care be taken in leveling the test plate.[2]

Appendix B

Seasoning Schedules for Lamps

(See "I.E.S. Guide for the Photometric Testing of Floodlights of 10 to 160 Degrees Total Beam Spread," Illuminating Engineering, Vol. XLVI, p. 165, March 1951.)

Bibliography

1. Appendix C of "I.E.S. Guide for Photometric Testing of Street Lighting Luminaires, 1948," Illuminating Engineering, Vol. XLIV, pp. 416-423 (July 1949).

2. Walsh, J. W. T.: *Photometry*, Constable & Co., Ltd. (London), pp. 341-376 (1925).

3. Report of Committee on Photoelectric Photometers, *Trans., I.E.S.*, Vol. XXXII, p. 379 (April 1937).

4. Sharp, C. H., and Little, W. F.: "Compensated Test Plate for Illumination Photometers," *Trans., I.E.S.*, Vol. X, p. 727 (November 1915).

5. British Standard 230: 1945, "Visual Type Portable Photometers," British Standards Institution, 28 Victoria Street, London, S.W. 1, England.

6. "Recommendations Concerning the Use of Portable Photometers, particularly for Street Lighting Measurements," *Trans., I.E.S.* (London), Vol. II, p. 62 (May 1937).

7. Little, W. F.: "Practical Hints on the Use of Portable Photometers," *Trans., I.E.S.*, Vol. X, p. 766 (November 1915).

8. Communicated: "A Photoelectric Street Lighting Photometer," *Illuminating Engineer* (London), Vol. XXVIII, p. 48 (February 1935).

9. English, S.: "Some Properties of Cells Used in the Holophane Edgcumbe Autophotometers," *Illuminating Engineer* (London), Vol. XXVIII, p. 94 (March 1935).

10. British Standard 667: 1945, "Photoelectric Type Portable Photometers," British Standards Institution, 28 Victoria Street, London, S.W. 1, England.

11. Buck, G. B.: "The Correction of Light Sensitive Cells for Angle of Incidence and Spectral Quality of Light," Illuminating Engineering, Vol. XLIV, No. 5, p. 293 (May 1949).

Reprints of the I.E.S. Guide for Outdoor Illumination Tests will soon be available in booklet form. Address orders to Publications Department, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

TELECAST

LIGHTING NEWS OF CURRENT INTEREST

Council Executive Committee Meets in New York

The I.E.S. Council Executive Committee met at the new offices of the Society Headquarters, at 1860 Broadway, New York City, on July 12. Braving New York's humidity were: Walter Sturrock, President, E. M. Strong, Vice-President, A. H. Manwaring, General Secretary, R. F. Hartenstein, Treasurer, A. D. Hinckley, Executive Secretary, and C. E. Ellis, Advertising and Promotion Manager.

A report from the General Board of Examiners reported the election and transfer of 90 Associate Members and 12 Students, and recommended the approval of 8 Members. Favorable action by the Committee on these elections, brings the membership figure to date, to those shown in the following tabulation:

September 30, 1950		July 12, 1951
7057	Total Membership	7166
32	Members Emeritus	32*
41	Fellows	42
1610	Members	1709
5005	Associate Members	5174
369	Student Members	209

*Includes 10 Fellows of the Society.

Committee reports presented included statements from the Finance Committee, Publications Committee, Local Activities, and Sustaining Membership. The latter recommended for election a new Sustaining Member:

New York State Electric & Gas Corp.
62 Henry St.,
Binghamton, N. Y.
Earl C. Edwards, Official Representative

The Publications Committee, C. E. Ellis, Advertising and Promotion Manager reporting, outlined distribution plans for the forthcoming new IES Lighting Handbook. He further reported the printing of a complete Directory of I.E.S. Membership, available to members at $2.00 a copy. Action was taken to make this Directory available to nonmembers also.

Excellent programs by Student Branches were reported by E. M. Strong, Chairman of the Local Activities Committee. He mentioned also evidence of prospective new Chapters at several points in the country, including Phoenix, Arizona, Atlantic City, N. J., and Tulsa, Okla., indicating that further effort toward new Chapter development would be recommended to the incoming Local Activities Committee.

Philadelphia Section Fall Course Announced

A course in Fundamentals in Illumination to be held next October 4, 1951 to March 13, 1952 has been announced by the Philadelphia Section, I.E.S. Plans for the comprehensive lighting course are already completed, and notices mailed, as early as last May.

Co-sponsor with the Philadelphia Section will be the Spring Garden Institute, in whose evening School classes will be held Thursday evenings for 20 sessions. Tuition for the course is $25.00.

Problems listed for discussion include:

October 4—Light and Vision, Dr. Geo. S. Crampton, Ophthalmologist.

October 11—Light Standards and Terminology, George E. Shoemaker, Philadelphia Electric Company.

October 18—Light Measurements, Leo Duval, Sylvania Electric Products, Inc.

October 25—Light Control I, Robert Herr, Philadelphia Electric Company.

November 1—Light Control II (Glare), Robert Herr, Philadelphia Electric Company.

November 8—Light Sources I, A. S. Turner, General Electric Company.

November 15—Light Sources II, A. S. Turner, General Electric Company.

November 29—Auxiliary Equipment & Circuit for Sources, W. N. Harrison, Philadelphia Electric Company.

December 6—Color and Lighting, G. W. Wagner, Philadelphia Electric Company.

December 13—Review, A. S. Turner, General Electric Company.

January 3—Lighting Calculations, R. H. Beisswenger, Silvray Lighting, Inc.

January 10—Light for Office, C. C. Shotwell, Philadelphia Electric Company.

January 17—Light for School, C. C. Shotwell, Philadelphia Electric Company.

January 24—Light for Selling, Robin Adair, Westinghouse Electric Corporation.

January 31—Light for Manufacturing, A. A. Brainerd, Philadelphia Electric Co.

February 7—Street Lighting, R. M. Hoot, Philadelphia Electric Company.

February 14—Lighting Surveys, M. N. Flynn, Philadelphia Electric Company.

February 28—Selection of Equipment, P. B. Thorne, General Electric Company.

March 6—Economics and Maintenance, Howard Miller, Utilities Engineering Company.

March 13—Review, George E. Shoemaker, Philadelphia Electric Company.

Job Opportunities In the Illumination Field

A survey of job opportunities in illumination was undertaken recently by the I.E.S. Student Branch at the City College of New York. The results of their project were presented in a formal report to the Board of Managers of the I.E.S. New York Section.

The purpose of the survey was to determine the employment situation in Illumination and the allied fields, and to obtain positions for the graduating members of the C.C.N.Y. Student Branch, and to relate to all other interested parties the possibilities of making a career in the field of illumination.

In order to perform the survey a list of utility and manufacturing organizations was compiled from the list of Sustaining Members published by the Illuminating Engineering Society.

To each of these organizations, a letter of application and concise resumé was mailed, each outlining the applicant's background in illumination. It was the group's opinion that sending a letter applying for a position rather than the usual questionnaire would better serve this purpose, thus placing the activity

on a more personal level. It was felt that the company, on receiving such a letter and resumé, would then give a true picture of job possibilities. In this manner, better responses might be obtained, and an actual, and not theoretical, type survey could be made.

The number of letters sent throughout this country and Canada was 315. Of the letters, sent, 137 replies were received, one month being allowed for answers. The compilation of replies were broken up into three categories: definite no's, yes's, and possibilities for future employment. The total number of no's were 14 in the manufacturing line and 11 in utilities; giving a total of 25 no's or 18.3 per cent no's of the total replies. The total number of acceptances for employment were 11 in manufacturing and 16 in the utilities; giving a total number of 27 acceptances or by percentage 19.7 per cent of the total replies. The number of future employment possibilities that were received were 45 in utilities and 40 in the field of manufacturing; giving a sum total of 85 or a percentage of 62 per cent of the replies received.

The replies received then were subdivided into the three territorial land divisions of the United States and Canade, in order to show where the greater abundance of jobs are in the illumination field. By compiling these data, it was noted that the best employment opportunities are in the East and Mid-west sections of the United States.

After considering all the replies, the conclusions drawn by the C.C.N.Y. Committee, as outlined in their formal report were that:

a) It is not wise to concentrate solely on the field of lighting for future employment, but to diversify your education in other fields as well, such as power, communications and the field of sales engineering. Thus with a diversified background of this type, the adage of "putting your eggs in one basket" will not apply.

b) Although the minority of the replies had concrete offers, it should be noted that a large majority of the letters received contained encouragement and advice in finding employment in the field.

c) The viewpoint of the majority of the companies could well be changed concerning the employment of technical help. The manufacturers in the field should realize that it has been only through the aid of the technical men in lighting that the rapid expansion of the lighting industry has taken place. The attitude of one large utility that lighting is not an engineering function is not only incorrect, but will be very costly to them in the future.

d) That most of the offers for employment came from the largest manufacturers and utility organizations in the field. These organizations realize to a larger extent the need of technical men.

e) The survey shows that the utilities, in the large majority, reject the idea of hiring recent graduates. This opinion seems to agree with the recent article in *Electrical World* publication of April 23, 1951, which states that the utility organizations are losing their opportunity at the last large graduating class of engineers. The article relates that the utility companies are losing graduates to the higher paying private industries and the only cure would be that the utilities raise their minimum wage and start an extensive program to train engineers in power and lighting with an eye to the future shortage of technical men. The estimates are that there will be a deficiency of 40,000 engineers by 1954.

f) That the fields of light and power are related in the respect that the utilities are eager to hire men who major in power and have a good background in illumination; thus it is essential that students taking power should by all means take a general course in illumination.

The members of the committee conducting the survey were: Arnold Sher, Walter Novik, Alvin Daly, Alexander Blummenstock, Paul Giordiano, Stanley Sisskind. All are graduating seniors of the City College of New York, and members of the I.E.S. Student Branch at C.C.N.Y.

THE HIGHLY SUCCESSFUL Lighting for Mobilization meeting held May 25 by the Milwaukee Section was under the guidance of (left to right) Earl Alk, Program Chairman; I. L. Illing, Sessions Chairman; and C. N. Laupp, Regional Vice-President and Milwaukee Section Chairman. Over sixty per cent of the total attendance of 180 were industrial users of lighting equipment. Dinner was held in the Hospitality Room at Blatz Brewing Company.

I.L.E. Merit Award Committee Now Mailing Entry Applications

Application blanks are now available for the 1952 Merit Award Competition sponsored by the Fourth International Lighting Exposition, to be held in Cleveland, Ohio, May 6-9, 1952. Deadline for the competition is January 31, 1952.

The Merit Award Competition is designed to afford an important opportunity to receive high industry recognition for outstanding lighting installations, with 25 Gold Seal Awards, and additional Merit Award Certificates. Successful entries will be exhibited in the Court of Honor at the Fourth I.L.E. and some $2,500 in cash prizes will be awarded.

G. T. Morrow, Chairman of the Merit Award Committee, urges prompt application for official entry blanks which are now available

Requests for application blanks and copies of official rule booklets should be addressed to: Merit Award Competition, 4th International Lighting Exposition and Conference, 326 West Madison St., Room 818, Chicago 6, Illinois.

Brightness Engineering!

Design for a new head for use with high brightness ratios, drawn by Louis J. Riegert, Twin City Section submitted by L. B. Paist.

Plant Maintenance Show To Be Held in Philadelphia

The Plant Maintenance Show, newest of the industrial expositions, will be held at Convention Hall, January 14-17, 1952.

The displays are expected to cover an area almost four times that of the first show in 1950 with more than 200 companies expected to participate.

Concurrently with the show will be the Plant Maintenance Conference, L. C. Morrow, consulting editor, *Factory Management and Maintenance*, serving as chairman.

Advance registration cards and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Avenue, New York, N. Y., the exposition management.

Fluorescent Lamp Standards Available

After five years of study and investigation, standards of interchangeability for 30 different types and sizes of fluorescent lamps have just been approved and published by the American Standards Association, 70 East 45th Street, New York 17, N. Y. These standards make it possible for consumers to specify a lamp of a given type with the assurance that lamps made by any of the various manufacturers will be mechanically and electrically interchangeable.

These standards fully describe each lamp under the headings—lamp designation, dimensional characteristics, operating characteristics, and starting requirements. The lamp dimensions listed are those necessary for drawing plans for the manufacture of lamp holders, lighting fixtures, and lighting installations.

(*Continued on page 9A*)

LIGHTING CALENDAR

Society Events

August 27-30, 1951 — Illuminating Engineering Society, National Technical Conference, Hotel Shoreham, Washington, D. C.

October 11, 1951—Meeting of I.E.S. National Council, New York, N. Y.

November 8, 1951—Meeting of I.E.S. Council Executive Committee.

December 13, 1951—Meeting of I.E.S. National Council, New York, N. Y.

January 10, 1952—Meeting of I.E.S. Council Executive Committee.

February 14, 1952—Meeting of I.E.S. National Council, New York, N. Y.

March 13, 1952—Meeting of I.E.S. Council Executive Committee.

March 13-14, 1952—South Pacific Coast Regional Conference, San Francisco, Calif.

March 20-21, 1952 — Pacific Northwest Regional Conference, Vancouver, B. C.

March 31, 1952—Meeting of I.E.S. National Council, Chicago, Ill. (Tentative)

April 6-8, 1952—Southwestern Regional Conference, Hotel Tulsa, Tulsa, Okla.

April 20-22, 1952—Southern Regional Conference, Hermitage Hotel, Nashville, Tenn.

April 30 - May 2, 1952—Canadian Regional Conference, Hotel General Brock, Niagara Falls.

May 5-6, 1952—Great Lakes Regional Conference, Statler Hotel, Cleveland, Ohio.

May 8, 1952—Meeting of I.E.S. Council Executive Committee.

May 22-23, 1952—East Central Regional Conference, Webster Hall Hotel, Pittsburgh, Pa.

June 12, 1952—Meeting of I.E.S. Council, New York, N. Y.

June 19-20, 1952 — Northeastern Regional Conference, Hotel Preston, Swampscott, Mass.

July 10, 1952 — Meeting of I.E.S. Council Executive Committee.

September 8-13, 1952 — Illuminating Engineering Society, National Technical Conference, Edgewater Beach Hotel, Chicago, Ill.

Industry Events

August 20-23, 1951 — Pacific General Meeting, American Institute of Electrical Engineers, Multnomah Hotel, Portland, Ore.

September 11-20, 1951 — Building Research Congress, London, England

September 17-20, 1951 — International Municipal Signal Association, 56th Annual Meeting, Mark Hopkins Hotel, San Francisco, Calif.

September 24-27, 1951—22nd Annual Meeting, Institute of Traffic Engineers, Ambassador Hotel, Los Angeles, Calif.

September 25-28, 1951 — Fall Meeting, The American Society of Mechanical Engineers, Hotel Raddison, Minneapolis, Minn.

September 26-28, 1951 — Annual Meeting, Canadian Electrical Manufacturers Ass'n, General Brock Hotel, Niagara Falls, Ont.

October 1-3, 1951—Eastern Section, International Association of Electrical Inspectors, Chalfonte-Haddon Hall, Atlantic City, N. J.

October 4-6, 1951—American Physical Society, Gaseous Electronics Fourth Conference, General Electric Research Laboratory, Schenectady, N. Y.

October 8-12, 1951 — 39th National Safety Congress & Exposition of the National Safety Council, Chicago, Ill.

October 9-10, 1951—National Farm Electrification Conference, Hotel Gibson, Cincinnati, Ohio

October 9-12, 1951 — National Electrical Contractors Associations, Annual Convention, Shoreham Hotel, Washington, D. C.

October 10-13, 1951 — The Electrochemical Society, Inc., Semi-Annual Convention, Statler Hotel, Detroit, Mich.

October 10-13, 1951 — International Association of Electrical Leagues, Annual Conference, Roosevelt Hotel, New Orleans, La.

October 15-17, 1951 — International Association of Electrical Inspectors, Southern Section, 23rd Annual Meeting, Hotel John Marshall, Richmond, Va.

October 15-19, 1951 — Fall 1951 Convention of the Society of Motion Picture and Television Engineers, Hollywood-Roosevelt Hotel, Hollywood, Calif.

October 22-24, 1951—33rd Annual Meeting, American Standards Ass'n, Waldorf-Astoria Hotel, New York, N. Y.

October 22-24, 1951 — National Electronics Conference, Annual Conference, Edgewater Beach Hotel, Chicago, Ill.

October 22-26, 1951 — American Institute of Electrical Engineers, Fall General Meeting, Hotel Cleveland, Cleveland, Ohio

October 28-31, 1951—National Association of Electrical Distributors, Board of Governors, The Homestead, Hot Springs, Va.

November 12-15, 1951 — National Electrical Manufacturers Association, Chalfonte-Haddon Hall, Atlantic City, N. J.

November 25-30, 1951 — Annual Meeting, The American Society of Mechanical Engineers, Atlantic City, N. J.

December 2-5, 1951 — American Society of Refrigerating Engineers, 47th Annual Meeting, Hotel Roosevelt, New York, N. Y.

December 5-7, 1951 — Annual Meeting, National Association of Manufacturers, Waldorf-Astoria Hotel, New York, N. Y.

January 6-12, 1952 — The 4th Pan American Congress of Ophthalmology, Del Prado Hotel, Mexico City

January 14-17, 1952 — Plant Maintenance Show, Convention Hall, Philadelphia, Pa.

January 21-25, 1952—Winter General Meeting, American Institute of Electrical Engineers, Hotel Statler, New York, N. Y.

March 10-13, 1952 — National Electrical Manufacturers Ass'n, Edgewater Beach Hotel, Chicago, Ill.

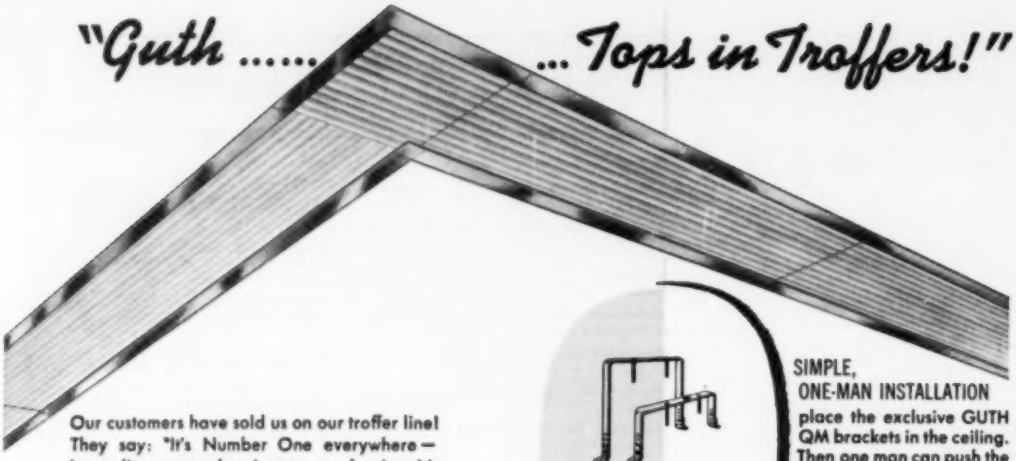
April 1-3, 1952 — Edison Electric Institute, Sales Conference, Chicago, Ill.

May 6-9, 1952 — Fourth International Lighting Exposition & Conference, Cleveland Municipal Auditorium, Cleveland, Ohio

June 23-27, 1952 — Summer General Meeting, American Institute of Electrical Engineers, Hotel Nicollet, Minneapolis, Minn.

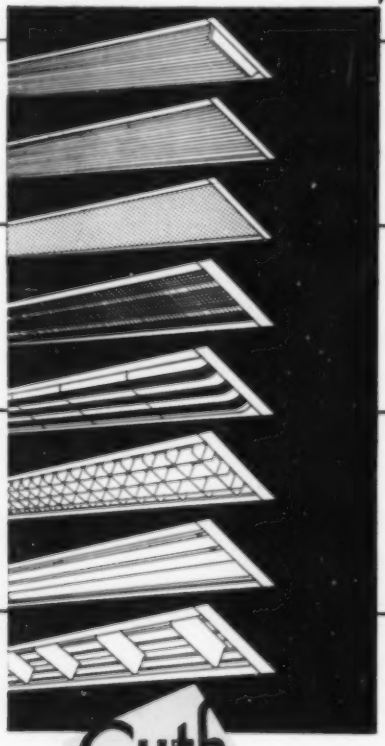
August 18-22, 1952 — Pacific General Meeting, American Institute of Electrical Engineers, Phoenix, Arizona.

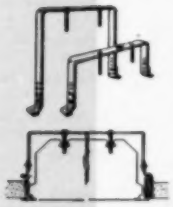
"Guth ....Tops in Troffers!"



Our customers have sold us on our troffer line! They say: "It's Number One everywhere—in quality, comprehensiveness, and price. It's great!"

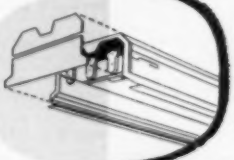
Look how easy it is to install and maintain GUTH Troffers:





SIMPLE, ONE-MAN INSTALLATION

place the exclusive GUTH QM brackets in the ceiling. Then one man can push the Troffer into place. Brackets grip the Troffer automatically, allowing it to be adjusted for perfect fit and fastened with wing nuts. That's all—simple, isn't it?

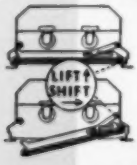


MODULAR LENGTHS WITHOUT TRIMMING

Troffers fit ceiling block openings in lengths of 2', 4', 5', 6', and 8'.

WIDE OPEN WIREWAY

wires are pulled through quickly and easily. How the contractor loves this feature!



MONEY-SAVING MAINTENANCE

glass framed and eggcrates are hinged for easy relamping and cleaning. Slide-in reflectors are easy to remove and replace—no latches or nuts to bother with. Ballast can be replaced without removing fixture.

UNBROKEN RIBBONS OF LIGHT

no metal joints — no divider shadows.

1-, 2-, 3- AND 4-LAMP SIZES

all with the same cross section—may be combined for perfect fit in one "strip".

ALL POPULAR LIGHT SOURCES

top lighting efficiency with Standard, Slimline, and Low Brightness lamps—in a total of 24 wattage sizes.

Write for Bulletin 869-I.

Guth LIGHTING

THE EDWIN F. GUTH COMPANY / ST. LOUIS 3, MISSOURI

Leaders in Lighting Since 1902

(Continued from page 7A)

The lamp types included are: preheat-start, instant-start, single-pin hot-cathode, bactericidal and cold-cathode electric discharge lamps, all in various lamp sizes.

Copies of the standards for any of the various lamp sizes, may be obtained from the American Standards Association, 70 East 45th Street, New York 17, N. Y., at 25 cents per copy.

Officers Elected by Chicago Residential Lighting Forum

Officers and Committee Chairmen have been chosen by the newest of the Residential Lighting Forums—Chicago. They are:

Chairman—Wm. K. LeBold, University of Illinois.
Vice-Chairman—Lois Fetherston, Architect.
Secretary—Kerr Sanders, Chicago Lighting Institute.
Executive Board—Ethel Lundquist, Lightolier, Inc.; Mary Campbell, Public Service Co. of Northern Illinois; John Devereaux, Kohl Manufacturing Co.; E. F. McDonnell, Jr., Commonwealth Edison Co.
Program Chairman—Albert Kurtzon, Aloko Manufacturing Co.
Publicity Chairman—Robert Lee, General Electric Co.
Membership Co-Chairmen—Sophia Malicki, Commonwealth Edison and Douglas Robinson, Westinghouse Electric.
Attendance and Reception—Jeanne Heidler, Public Service Co. of Northern Illinois.

ENROLLMENT of eighty professional women from thirty-two states, Denmark and the Netherlands attended the two-day Home Educators Lighting Conference in Cleveland.

Home Educators Lighting Conference Holds Two-Day Session

The Educators Conference, offered and designed for Home Economists in the teaching profession held its 1951 conference—fourth of its type—at Nela Park, Cleveland June 22 and 23, just preceding the national convention of the American Home Economics Association. The enrollment of 80 included professional women from 32 states, as well as from Denmark and The Netherlands.

Visual demonstration highlighted the two-day concentrated program which was developed by the Residence Lighting Section of the Engineering Department of the General Electric Co. The subject material illustrated the principles and techniques of recommended home lighting practice in terms of human value. Emphasis was on the basic correlation of lighting to home making and family living.

(Telecast continued on page 11A)

Installations to See When You Visit Chicago

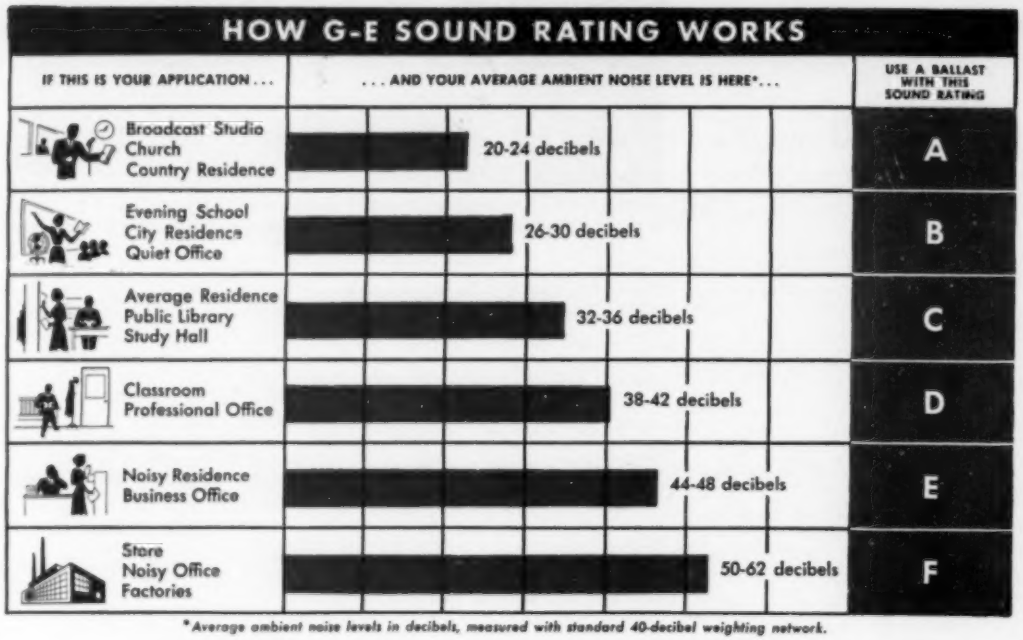
Class of Job	Installation at	Address	Types of Lighting
Bank	First Nat'l. Bank	Clark & Monroe	Incandescent downlighting
Bank	First Nat'l. Bank	Joliet, Illinois	Louverall ceiling
Bowling Alley	Rival's Club	1425 N. Broadway, Joliet, Ill.	Saw tooth ceiling with fluorescent
Church	Sinai Temple	5350 South Shore Dr.	Fluorescent coves and incandescent downlights
Cosmetic Shop	Helena Rubensteins	666 N. Michigan	Fluorescent coves and downlighting
Clothing (genl.)	Bonds	234 S. State	Fluorescent louvered bays
Clothing (women's)	Marshall Field & Co.	State & Washington	Indirect fluorescent
Clothing	Lytton's	112 N. Chicago, Joliet, Ill.	Fluorescent coves and incandescent downlights
Drafting Room	Ill. Bell Telephone	212 W. Washington	Semi-indirect fluorescent
Hardware Store	Barrett Hardware	65 N. Ottawa St., Joliet, Ill.	Fluorescent with built in spots
Jewelry	Erwin Jewelry	110 N. Chicago St., Joliet, Ill.	Combination louvered fluorescent with recessed down lights
Music Store	Lyon & Healy	241 S. Wabash	Custom built fluorescent suspended squares
Office	Commonwealth Edison	72 W. Adams St., Rm. 1296M	Surface mounted glass bottom fluorescent
Restaurant	Hotel Sherman (Coffee Shop)	Clark & Randolph	Indirect fluorescent Colonial style incandescent and fluorescent cove
Restaurant	Pick-Congress Corp.	500 S. Michigan	Fluorescent cove
Restaurant (Cafeteria)	Walgreens	4 North State	Incandescent downlights
Restaurant (Cafeteria)	Ill. Bell Telephone	212 W. Washington	Flush Troffers—Fluorescent counter lighting
Restaurant (Cafeteria)	Commonwealth Edison	72 W. Adams St.	Recessed Troffers
Restaurant (Luncheon Rm.)	DeMets	135 S. State	Reverse cove cold cathode ceiling slots
Schoolroom	P. E. Marsh School	Cass & Eastern Ave., Joliet, Ill.	Direct-indirect two-lamp low brightness fluorescent
Shoe Store	Chandlers	131 S. State	Pin hole spots, recessed louvered slimline
Streetlighting	Chicago	1600 N. Lake Shore Dr.	Mercury vapor
Streetlighting	Kankakee, Illinois	Court St.	Mercury vapor

Compiled by the Chicago Section, I.E.S.

NOW! G-E BALLASTS ARE SOUND RATED*

***SOUND-RATING: G. E.'s new classification of ballasts to guide you in the correct application of fluorescent fixtures.**

HOW G-E SOUND RATING WORKS



*Average ambient noise levels in decibels, measured with standard 40-decibel weighting network.

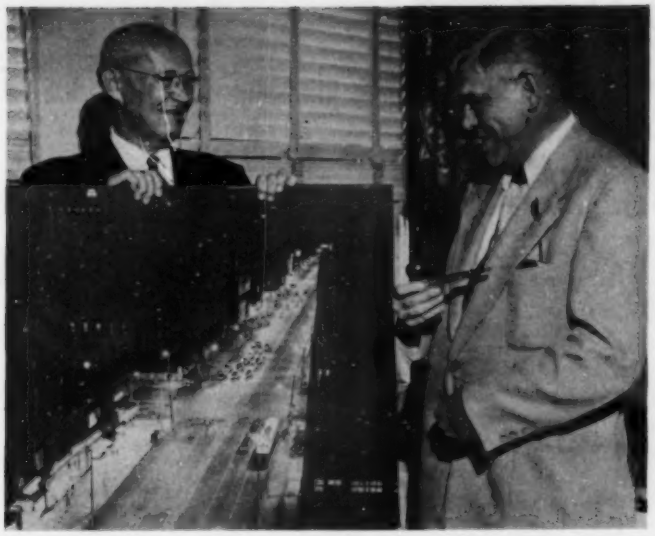
A new tool to help you build greater customer satisfaction by minimizing noise complaints

Every fluorescent ballast has a normal, magnetic hum. But now, for the first time, you can know the relative sound level of the ballast before you buy. For G-E engineers have pioneered a system for measuring ballast sound levels accurately. These measurements have led to six classifications: from "A"—extremely quiet, to "F"—quite audible. This means that you know, before installation, which ballasts are right for any given application—whether it be church, school, noisy factory area, or any one of a wide range of other locations.

Take the first step toward eliminating customer complaints about objectionable noise. Write for GEA-5672, a four-page bulletin which explains Sound Rating in detail. A reprint of recent technical information (GER-36) is also available. Write Section 412-93, *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

412-93



OHIO VALLEY Section extension meeting in Dayton, Ohio, celebrates that city's new mercury vapor street lighting installation. Displaying a picture of the installation is, left, J. Bosway and, right, H. S. Nonneman.

Dayton Hosts to Ohio Valley Section Meeting

Dayton, Ohio celebrated the completion of its new downtown mercury vapor street lighting installation June 20, with a big dinner meeting sponsored jointly by the I.E.S. Ohio Valley Section, Dayton Chapter of A.I.E.E., and the Dayton Safety Council. H. S. Nonneman, Municipal Representative of the Dayton Power & Light Co. and I.E.S. member, acted as toastmaster.

Speakers at the meeting included Mayor L. W. Lohrey of Dayton, Dr. A. F. Dickerson, Manager, Lynn River Small Apparatus Division, General Electric Company, and Kirk M. Reid, Street Lighting expert of General Electric Company, Nela Park, Cleveland, Ohio. Dr. Dickerson and Mr. Reid are both I.E.S. members.

Following the talks the group of 150 members and guests adjourned to a blocked-off section of one of the streets recently lighted to view operation of the lighting and witness the use of the latest General Electric mobile recording footcandle meter equipment.

The newest installation shown in the illustration is in a five-mile-square downtown section covering ten of the city's main streets. Six hundred mercury-vapor lamps have been installed at 28-ft mounting heights on existing and new steel poles. According to city safety officials and representatives of the Dayton Power & Light Company, this is the largest, most complete installation of its kind in any city of comparable size in the country.

The new units replace 561 old incandescent fixtures and are equipped with 20,000-lumen lamps. Illumination level has been increased from .76 to 3.0 footcandles — almost 400 per cent.

Flashlights Work Under Water

Virtually any flashlight can be operated successfully under water in the event of an emergency, such as a drowning, or the loss of a valuable ring, according to Gwilym F. Prideaux, miniature lamp specialist for General Electric Co. Failure to realize this little known fact often means the loss of precious time in the search for the body of a drowning person, he said.

If the water is reasonably clear, it is possible for a diver to see a "considerable distance" with the aid of a five-cell flashlight. In the event the water is muddy, however, even the most powerful diving lamps, such as one of 1000-watts, will throw a beam only a few feet.

Mr. Prideaux cautioned that for best results the cover glass of the searchlight should be broken and the bulb should not be lighted until submerged.

See list of Sustaining Members beginning on page 14A

NEW MEMBERS

At the meeting of the Council Executive Committee held in New York City on July 12, 1951, the following were elected to membership:

BRITISH COLUMBIA SECTION

Associate Members:

Sinclair, K. I., Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, B. C.

Williams, E. C., Eric Ackland & Associates, Ltd., Vancouver, B. C.

CAPITAL SECTION

Member:

Rubel, W. L., Guy B. Panero Engineers, Inc., Washington, D. C.

Associate Members:

Cohen, Albert, National Bureau of Standards, Washington, D. C.

Gibson, Mrs. Audrey L., Westinghouse Electric Corp., Washington, D. C.

Woody, R. P., Post Office Dept., Washington, D. C.

CAROLINAS CHAPTER

Associate Members:

Butler, S. M., Sr., Butler Mfg. Co. Inc., Lincolnton, N. C.

Butler, S. M., Jr., Butler Mfg. Co. Inc., Charlotte, N. C.

CENTRAL NEW YORK CHAPTER

Associate Member:

Platt, N. L., St. John & Platt, Binghamton, N. Y.

CHICAGO SECTION

Associate Members:

Buehler, E. F., J. C. Schaefer Electric, Inc., Peoria, Ill.

Butler, C. M., Jefferson Electric Co., Bellwood, Ill.

Carlton, G. A., Guy Carlton Electric, Bloomington, Ill.

Connell, F. K., Holophane Co., Inc., New York, N. Y.

Davis, E. H., Foster Electric Co., Peoria, Ill.

Dunne, E. J., A. O. Smith Corp., Kankakee, Ill.

Grawey, C. A., Fred V. Grawey Electric, Peoria, Ill.

Hutt, G. J., Graybar Electric Co., Peoria, Ill.

Leonard, D. C., Caterpillar Tractor Co., Peoria, Ill.

Marks, Gerald, Electric Supply Co., Chicago, Ill.

Martin, W. J., Champion Lamp Works, Chicago, Ill.

Waddell, R. H., Sylvania Electric Products, Inc., Peoria, Ill.

CLEVELAND SECTION

Student Member:

Wirth, F. T., Case Institute of Technology, Cleveland, Ohio.

CONNECTICUT SECTION

Associate Members:

Conway, J. N., Jr., Graybar Electric Co., Inc., New Haven, Conn.

Cronin, G. H., 33 Center St., Waterbury, Conn.

CORNHUSKER CHAPTER

Associate Member:

Pearson, H. A., 201 S. Hiawatha, Pipestone, Minn.

EASTERN PENNSYLVANIA CHAPTER

Associate Members:

Botvinick, Samuel, All Brite Light Co., Reading, Pa.

Root, J. M., Sylvania Electric Products, Inc., Philadelphia, Pa.

FLORIDA CHAPTER

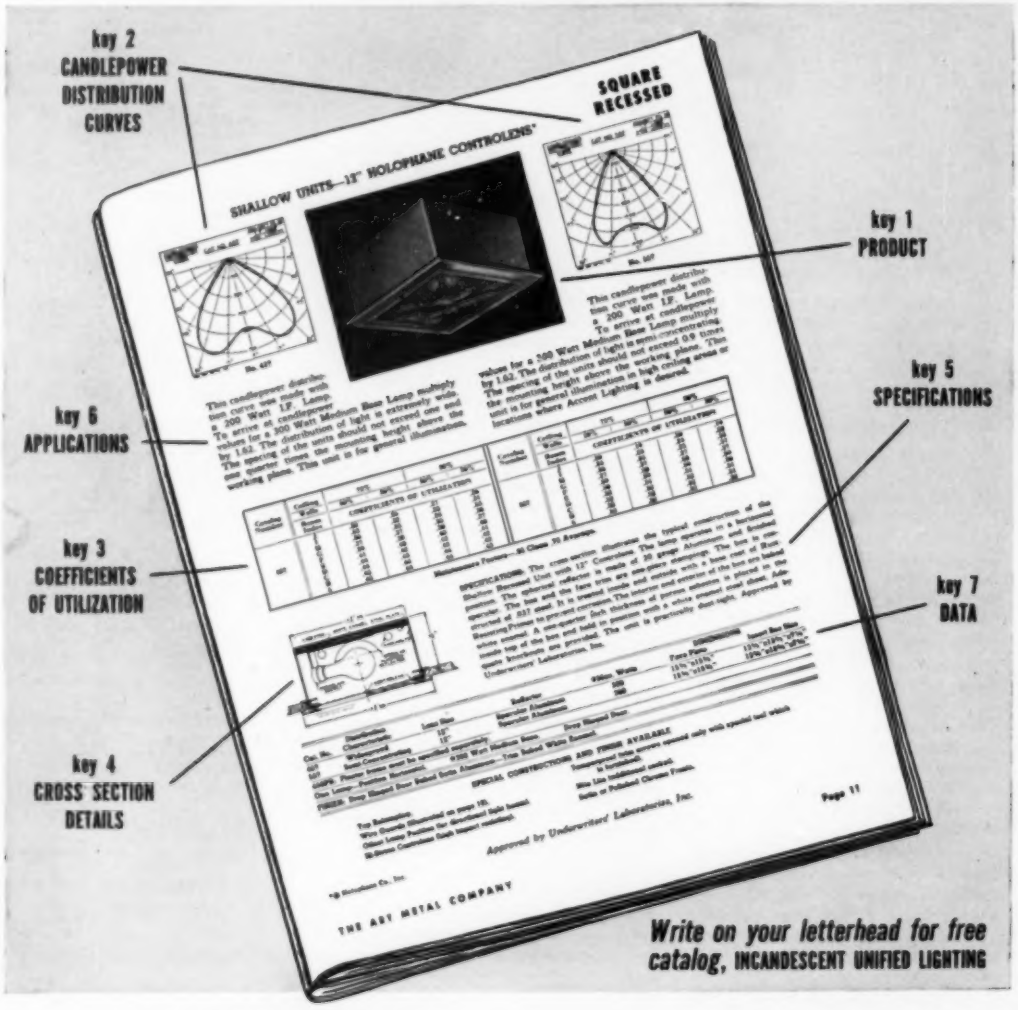
Associate Members:

Healy, J. L., Newcomb Electric Co., Daytona Beach, Fla.

Keesler, A. J., Westinghouse Electric Supply Co., Tampa, Fla.

(Continued on page 29A)

7 KEYS provided by ART METAL to speed specification writing and installation planning for all types of INCANDESCENT LIGHTING



THE ART METAL COMPANY • CLEVELAND 3, OHIO

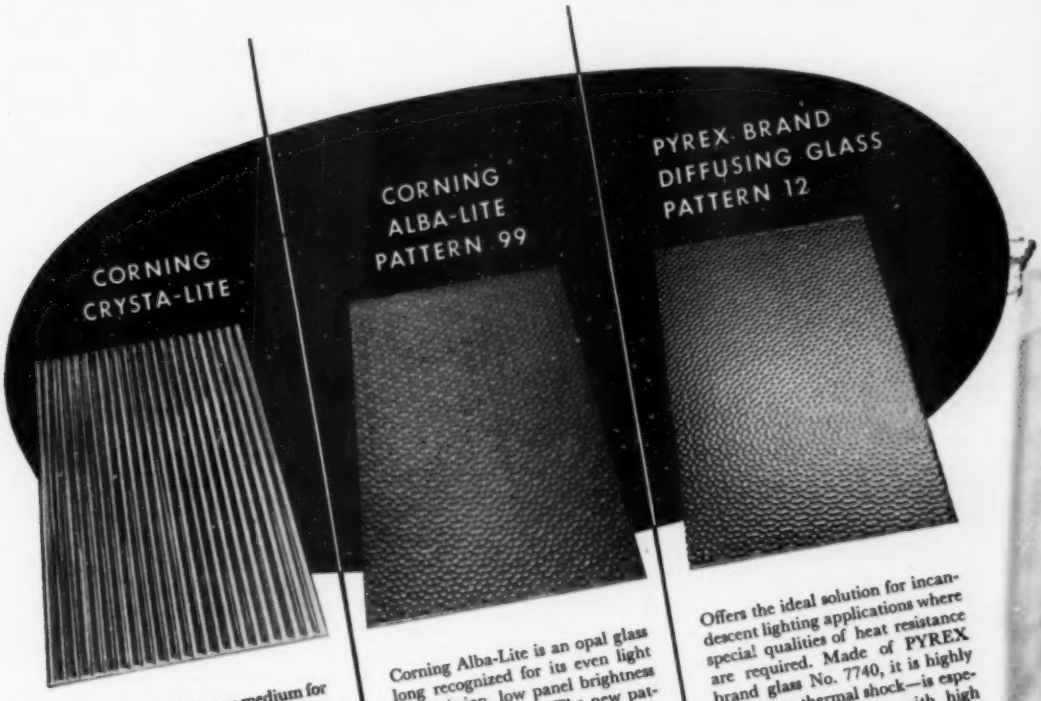
Manufacturers of Unified Lighting Equipment for Office, Store, School, Hospital and Hotel

Art Metal Unified Lighting standardizes the design, style and finish of each unit, to achieve an architecturally integrated installation.

ANNOUNCING

Three New Additions To Corning Engineered Lightingware

As a result of a continuing effort to give you new and better lightingware, Corning research has developed three new additions to the Corning line. Like all Corning Engineered Lightingware, they provide maximum efficiency, effective light control, and design flexibility. The coupon below will bring you complete information on these important new products. Mail it today.



Here is an entirely new medium for prismatic control of fluorescent light. Utilizing linear prisms, it controls the distribution of light by bending high angle rays downward into zones where they are useful for illumination—gives you higher intensities with fewer fixtures and accurate brightness control. Efficiency is high. Made of water-white crystal, Corning Crysta-Lite is light in weight and non-color selective. Available in widths up to 24", lengths up to 100".

Corning Alba-Lite is an opal glass long recognized for its even light transmission, low panel brightness and high efficiency. The new pattern 99 is uniformly pebbled on one side to give greater "hiding power" —outline of light source is completely diffused. It makes for pleasing fixture appearance, is easy to clean. Available in (⅛" thick), widths up to 24" and lengths up to 100", Alba-Lite Pattern 99 is easily cut to special shapes or made into bends as required.

Offers the ideal solution for incandescent lighting applications where special qualities of heat resistance are required. Made of PYREX brand glass No. 7740, it is highly resistant to thermal shock—is especially suitable for use with high wattage lamps or in outdoor installations. The uniformly pebbled surface provides excellent diffusion and even illumination. Available in widths up to 24" and lengths up to 60" (⅛" thick), it can be cut to any required shape.

CORNING GLASS WORKS
CORNING, NEW YORK
1851 *Corning means research in Glass* 1951

CORNING GLASS WORKS, Dept. IE-8, Corning, N. Y.

Please send information on:

☐ Corning Crysta-Lite ☐ Alba-Lite Pattern 99
☐ PYREX brand Diffusing Glass Pattern 12

Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State_____

SUSTAINING MEMBERS

Acme Electric Corp.
Cuba, N. Y. *J. A. Comstock*

Advance Transformer Co.
1122 W. Catalpa Ave., Chicago 40, Ill.
Hirsch Epstein

Alabama Power Co.
Birmingham, Ala. *George L. Morris*

All Bright Electric Products Co.
3917-25 N. Kedzie Ave.,Chicago 18, Ill.
Max Klein

Aluminum Company of America
Gulf Building, Pittsburgh 19, Pa. *C. Braglio*

Amalgamated Electric Corp., Ltd.
584 Pape Ave., Toronto, Ont., Canada
W. A. Dalrymple

American Concrete Corp.
4727 North Lamon Ave., Chicago 30, Ill.
J. W. Lewis

American Fluorescent Corp.
5407 Broadway, Chicago, Ill. *William Rusnak*

American Steel and Iron Works
5801 South Lowe Ave., Chicago 21, Ill.
Walter H. Krueger

American Sterilizer Co.
Erie, Pa. *Horace Wm. Alexander*

Appleton Electric Co.
1701-1729 Wellington Ave., Chicago 13, Ill.
Nils A. Tornblom

Arkansas Power & Light Co.
Simmons National Bldg., Pine Bluff, Ark.
Max Sudduth

The Art Metal Co.
1814 E. 40th St., Cleveland 3, Ohio
George E. Glatthar

Bausch & Lomb Optical Co.
Rochester 2, N. Y. *Arthur E. Neumer*

Benjamin Electric Mfg. Co.
Des Plaines, Ill. *Benjamin S. Benson*

Blue Ridge Glass Corp.
P.O. Box 651, Kingsport, Tenn. *James Herbert*

Board of Water and Electric Light Commissioners
116 W. Ottawa St., P.O. Box 570, Lansing 3, Mich. *John D. Mainight*

Boston Edison Co.
39 Boylston St., Boston 12, Mass. *R. B. Brown, Jr.*

Branham, Mareck & Duegner, Inc.
7020 Walker St., St. Louis Park, Minneapolis 16, Minn. *Cecil H. Branham*

Bright Light Reflector Co., Inc.
Fairfield & State, Bridgeport 5, Conn. *R. J. Mott*

British Columbia Electric Rwy. Co., Ltd.
570 Dunsmuir St., Vancouver, B. C., Canada
H. N. Walters

Brockton Edison Co.
36 Main St., Brockton 67, Mass. *W. A. Forbush*

Edward F. Caldwell & Co., Inc.
101 Park Ave., New York 17, N. Y. *E. T. Caldwell*

California Electric Power Co.
P.O. Box 512, Riverside, Calif. *Robert W. Dowd*

Calpa Products Co.
4116 Chester Ave., Philadelphia 4, Pa.
Paul C. Calisti

Cambridge Electric Light Co.
46 Blackstone St., Cambridge 39, Mass.
Reginald H. Bowman

Canadian General Elec. Co., Ltd.
212 King St., Toronto, Ont. *R. M. Love*

Canadian Laco Lamps, Ltd.
745 Guy St., Montreal, Que. *J. Thomas*

Canadian Line Materials, Ltd.
Postal Station H, Toronto 13, Ont., Canada
L. E. Messinger

Central Hudson Gas and Elec. Corp.
50 Market St., Poughkeepsie, N. Y. *H. E. Dexter*

Central Illinois Light Co.
316 Jefferson Ave. S., Peoria 2, Ill. *R. K. Dallas*

Central Illinois Public Service Co.
607 E. Adams St., Springfield, Ill. *B. L. Palm*

Central Maine Power Co.
9 Green St., Augusta, Maine *Roland W. Hess*

Central Power & Light Co.
P.O. Box 2121, Corpus Christi, Texas
James M. Williams

Champion Lamp Works Div. of Consolidated Electric Lamp Co.
600 Broad St., Lynn, Mass. *Ellery H. Raddin*

Cincinnati Gas & Electric Co.
Fourth & Main Sts., Cincinnati 1, Ohio
J. R. Hartman

Circlite Corp.
118 So. Clinton St., Chicago, Ill. *George Gomberg*

City of Burbank, California Public Service Dept.
174 W. Magnolia Boulevard, Burbank, Calif.
J. H. McCambridge

City of Glendale Public Service Dept.
119 N. Glendale Ave., Glendale 6, Calif.
H. E. Gulick

City of Riverside Electric Light Dept.
3834 Mulberry St., Riverside, Calif.
L. W. Grayson

City of Seattle, Dept. of Lighting—Puget Sound
1015 Third Ave., Seattle 4, Wash. *P. C. Spowart*

City of Tacoma, Light Division
402 City Hall, Tacoma 2, Wash. *Roy H. Weston*

The Cleveland Electric Illuminating Co.
75 Public Square, Cleveland 1, Ohio
R. C. Hienton

Clyde Porcelain Steel Corp.
2211 Birdseye St., Clyde, Ohio *W. F. White*

Colonial Premier Corp.
466 W. Superior St., Chicago 10, Ill.
Richard Weis

Columbia Electric & Mfg. Co.
1024 West Ide Ave., Spokane, Wash.
Walter A. Toly

Commercial Light Co.
841 W. Washington Blvd., Chicago, Ill.
Michael R. Fine

Commonwealth Edison Co.
72 W. Adams St., Chicago 90, Ill.
Ralph G. Raymond

The Connecticut Light & Power Co.
250 Freight St., Waterbury 91, Conn.
Robert G. Ely

Consolidated Edison Co. of N. Y., Inc.
4 Irving Place, New York 3, N. Y. *C. Miller*

Consolidated Gas, Elec. Light & Power Co. of Baltimore
100 W. Lexington St.,Baltimore 1, Md.
M. C. Albrittain

Consumers Power Co.
212 Michigan Ave. W., Jackson, Mich. *D. E. Karn*

Consumers Public Power Co.
1452 25th Ave., Columbus, Nebr. *W. H. Sinke*

Corning Glass Works
Corning, N. Y. *A. S. Tylor*

Coyne Electrical School, Inc.
500 So. Paulina St., Chicago 7, Ill. *John Hanan*

Crescent Electric Supply Co.
765 Iowa St., Dubuque, Iowa *Titus B. Schmid*

Crouse-Hinds Co.
Syracuse 1, N. Y. *A. H. Clarke*

Crouse Hinds Co. of Canada, Ltd.
7 Labatt Ave., Toronto, Ont. *F. R. Jeffery*

Curtis Lighting, Inc.
6135 W. 65th St., Clearing Station, Chicago 38, Ill. *Darwin Curtis*

Curtis Lighting of Canada, Ltd.
195 Wicksteed Ave.,Leaside, Toronto 12, Ont.
H. L. Wright

Cutler Light Manufacturing Co.
2026-28 N. 22d St., Philadelphia 21, Pa.
Robert T. Cutler

Dallas Power & Light Co.
1506 Commerce St., Dallas 1, Texas *W. G. Moore*

Day-Brite Lighting, Inc.
5401 Bulwer St., St. Louis 7, Mo. *D. J. Biller*

The Dayton Power & Light Co.
25 No. Main St., Dayton, Ohio *H. S. Nonneman*

Dazor Manufacturing Corp.
4485 Duncan Ave., St. Louis 10, Mo. *P. L. Read*

Delaware Power & Light Co.
600 Market St., Wilmington 99, Del.
W. A. F. Pyle

Dept. of Water & Power, City of Los Angeles, Bur. of Power & Light
Box 3669, Terminal Annex, 207 So. Broadway, Los Angeles 54, Calif. *C. P. Garman*

Detroit Edison Co.
2000 Second Ave., Detroit 26, Mich. *L. E. Taylor*

Detroit Electrical Contractors Association
627-628 Hotel Book Cadillac, Detroit 26, Mich.
Carl J. Schoeniger

Detroit Steel Products Co.
2250 E. Grand Blvd., Detroit 11, Mich.
W. Clifton Randall

E. I. duPont de Nemours & Co., Inc. (Fabrics & Finishes Div.)
Wilmington 98, Del. *S. W. Quisenberry*

E. I. duPont de Nemours & Co., Inc. Polychemicals Dept.
Wilmington 98, Del. *R. E. Leary*

Duquesne Light Co.
435 Sixth Ave., Pittsburgh 19, Pa. *G. W. Ousler*

Duro Test Corp.
2321 Hudson Blvd., North Bergen, N. J.
James L. Cox

Eastern Fixture Co., Inc.
170 Vernon St., Boston 20, Mass. *Louis Gilman*

(Continued on page 16A)

(*Note:* Names of Official Representatives appear in italics.)

82 JOB-RATED industrial lighting units

there's a **DYNALITE** that's ***production-right*** for every job...

MITCHELL DYNALITE

You name the job—there's a new MITCHELL Industrial Lighting unit designed to put the *right light* over *any* production operation. There's nothing like the Dynalite Line—an unprecedented range of 82 *Job-Rated* lighting units you can specify with confidence for superior light in every working area. Advanced features, precision construction for easy installation and maintenance, built-in lifetime durability—that's Dynalite—the *complete* answer to today's industrial lighting needs. Get all the details on this outstanding line now!

THE COMPLETE, UNIFORM, IN-STOCK INDUSTRIAL LIGHTING LINE

- 6 LAMP TYPES AND SIZES
- 4 LAMPHOLDER TYPES
- 3 SHIELDING TYPES
- 2 REFLECTOR TYPES

THE *RIGHT* UNIT FOR EVERY JOB

4, 5, 8 and 10 foot lengths . . . 2, 3 and 4 lamp units . . . single, tandem and combination models for standard or alternate-spaced lighting. Continuous uniform wireway channel for easy planning of any installation *light-rated for the job.*

SEND FOR IT COMPLETE ILLUSTRATED ***DYNALITE CATALOG***

See how MITCHELL Dynalite custom-fits any industrial lighting job. Send today for the FREE Dynalite catalog—packed with full technical detail that makes it easy to specify *correct* industrial lighting. Write for it now.

MITCHELL MANUFACTURING COMPANY
2525 N. CLYBOURN AVE., CHICAGO 14, ILLINOIS
In Canada: Mitchell Mfg. Co., Ltd., 11-25 Davies Ave., Toronto

MITCHELL MANUFACTURING COMPANY
2525 N. Clybourn Ave., Chicago 14, Illinois

☐ Send Free descriptive catalog on MITCHELL "Dynalite" Job-Rated Industrial Lighting

Name .....

Firm Name .....

Address .....

City ..... *Zone* ... *State* .....

(Continued from page 14A)

East Side Metal Spinning & Stamping Corp.
1301 Elizabeth Ave., W., Linden, N. J.
M. A. Kremer

Ebasco Services, Inc.
2 Rector St.,New York 6, N. Y. *M. E. Stone*

Efengee Electrical Supply Co.
671 W. Washington Blvd., Chicago 6, Ill.
Lee Mirus

Electrical Information Publications, Inc.
20 N. Carroll St., Madison, Wis. *Lewis E. Johnson*

Electrical Testing Laboratories, Inc.
79th St. & East End Ave., New York City 21, N. Y.
W. F. Little

Electric Supply Corporation
701 W. Jackson Blvd., Chicago 6, Ill.
L. B. Mangione

Electro Manufacturing Corp.
2000 W. Fulton St., Chicago 12, Ill.
L. K. Schoenbrod

Electrolier Mfg. Company, Ltd.
5849 Boyer St., Montreal, Que., Canada
John Iseuman

Ender Manufacturing Corp.
260 West St., New York 13, N. Y. *Jules Levenstein*

Electron Corp.
5100 South Santa Fe, Littleton, Colo.
William H. Johnson

Englewood Electrical Supply Co.
5801-05 So. Halsted St., Chicago, Ill. *Ray O'Leary*

Fitchburg Gas & Electric Light Co.
537 Main St., Fitchburg, Mass. *A. G. Neal*

Florida Power & Light Co.
Box 3100, Miami 30, Fla. *C. B. Vick*

Fluorescent Equipment & Mfg. Co.
2570 Superior Ave., Cleveland 14, Ohio
Leonard S. Freeman

Fluorescent Fixtures of Calif.
3320 18th St., San Francisco 10, Calif.
Ernst O. Anders

Fluorescent Maintenance Co., Inc.
1480 S. Robertson Blvd., Los Angeles 35, Calif.
Leonard K. Black

Fluores-O-Lite Co.
Evans Terminal, No. Broad St., Hillside, N. J.
Meyer H. Silverman

The Fostoria Pressed Steel Corp.
Fostoria, Ohio *E. L. Bates*

H. A. Framburg & Co.
3320-28 Carroll Ave., Chicago 24, Ill.
Stanley A. Framburg

The France Mfg. Co.
10325 Berea Rd., Cleveland 2, Ohio *J. H. Mayne*

The Frankelite Co.
1425 Rockwell Ave., Cleveland 14, Ohio
Dave Frankel

Franklin Design Service, Division of Safeway Stores, Inc.
4th & Jackson Sts., P.O. Box 660, Oakland 4, Calif.
Wallace H. Lane

The Frink Corporation
27-01 Bridge Plaza North, Long Island City, N. Y.
Theo. J. Brassel, Jr.

Gallagher-O'Brien Electric Co., Inc.
712 N. State St., Chicago 10, Ill.
Frank A. Gallagher

Garden City Plating & Mfg. Co.
1750 No. Ashland Ave., Chicago 22, Ill.
G. G. Harney

General Electric Co., Apparatus Dept.
River Works, 920 Western Ave., West Lynn, Mass.
A. F. Dickerson

General Electric Co., Lamp Dept.
Nela Park, Cleveland 12, Ohio *Willard C. Brown*

General Electric Supply Corp.
1260 Boston Ave., Bridgeport, Conn.
W. W. Booth

General Lighting Products Co.
468 Frelinghuysen Ave., Newark 5, N. J.
Nathan H. Eglowstein

General Outdoor Advertising Co., Inc.
515 So. Loomis St., Chicago, Ill. *R. E. Nevius*

The Georgia Power Co.
Electric Building, Atlanta 1, Ga.
Charles A. Collier

Gibson Manufacturing Co.
1919 Piedmont Circle N. E., Atlanta, Ga.
R. R. Gibson

Gill Glass & Fixture Co.
Amber & Tioga Sts., Philadelphia 34, Pa.
C. A. Gill

Gillinder Brothers, Inc.
Erie & Liberty Sts., Port Jervis, N. Y.
J. Fletcher Gillinder

Gleason-Tiebout Glass Co.
59-50 54th St., Maspeth, N. Y.
Marshall T. Gleason

Globe Lighting Products Co., Inc.
1710 Flushing Avenue, Brooklyn 6, N. Y.
Isidor Rosenblatt

Godfrey and Wing, Inc.
2110 Superior Ave., Cleveland 14, Ohio
C. G. Wing

Golde Manufacturing Co.
1214 W. Madison, Chicago 7, Ill. *E. W. Goldberg*

Grand Rapids Store Equip. Co.
1340 Monroe Ave., N. W.,Grand Rapids 2, Mich.
Kenneth C. Welch

Graybar Electric Co., Inc.
420 Lexington Ave., New York 17, N. Y.
Raymond C. Kinney

Gulf States Utilities Co.
Box 2951, Beaumont, Texas *Clarence Barron*

The Edwin F. Guth Co.
2615 Washington Ave., St. Louis 3, Mo.
Fred E. Guth

The Hankins Container Co.
3044 W. 106th St., Cleveland 11, Ohio
Ray T. White

Hartford Electric Light Co.
266 Pearl St., Hartford 3, Conn. *Victor Ouellette*

Hawkins Electric Co.
1447 Washington Blvd., Chicago 7, Ill. *R. R. Hill*

Hendrickson-Heffernan Co., Inc.
45-17 Pearson St., Long Island City 1, N. Y.
Joseph T. Manucia

Holdwellite Co.
2301 Scranton Rd., Cleveland 13, Ohio
H. E. Ingraham

Holophane Company, Inc.
342 Madison Ave., New York 17, N. Y.
H. L. Logan

Home Light and Power Co.
810 Ninth St., Greeley, Colo. *C. Gilbert Dressor*

House-O-Lite Corporation
1100 West Washington Blvd., Chicago 7, Ill.
Jack R. Stone

Houston Lighting & Power Co.
P.O. Box 1700, Houston 1, Texas *W. J. Aicklen*

Hub Electric Company
2219 W. Grand Ave., Chicago 12, Ill.
I. M. Fixman

Hydro-Electric Power Comm. of Ont.
620 University Ave., Toronto, Ontario
R. L. Hearn

Hyland Electrical Supply Co.
700 West Jackson Blvd., Chicago, Ill. *J. A. Tills*

Illinois Power Co.
134 East Main St., (L Box 511 B), Decatur 70, Ill. *Allen Van Wyck*

Illuminating Engineering Co.
2347 E. Nine Mile Road, Hazel Park, Mich.
Bert C. Pretzer

Iowa Electric Light & Power Co.
Box 351, Cedar Rapids, Iowa *Sutherland Dows*

Iowa-Illinois Gas & Electric Co.
United Light Bldg., Davenport, Iowa
John M. Hollingsworth

Iowa Power and Light Co.
312 Sixth Ave., Des Moines 3, Iowa
N. Bernard Gussett

Iowa Public Service Co., East Div.
400 Commercial St., Waterloo, Iowa
C. R. Wagoner

Iowa Public Service Co., Sioux City Division
P.O. Box 778, Sioux City 4, Iowa *C. R. Tracy*

Jeannette Shade & Novelty Co.
N. Fourth St., Jeannette, Pa. *H. N. Crock*

Jefferson Electric Co.
Bellwood, Ill. *L. Mauerer*

Jersey Central Power & Light Co.
501 Grand Ave., Asbury Park, N. J. *D. J. Douglas*

Joleco Corporation
2513 Baldwin St., St. Louis, Mo. *George Ledbetter*

Jones Metal Products Co.
West Lafayette, Ohio *H. Boyer*

Joslyn Mfg. & Supply Co.
3700 So. Morgan St., Chicago 9, Ill. *J. H. Fahey*

Kansas City Power & Light Co.
P.O. Box 679, Kansas City 10, Mo.
John M. Arthur, Jr.

Kansas Gas & Electric Co.
P.O. Box 204, Wichita, Kans. *H. W. Hobson*

The Kayline Company
2480 E. 22d St., Cleveland 15, Ohio *M. A. Eskins*

Kelco-Burnett Electric Co.
223 W. Jackson Blvd., Chicago 6, Ill.
Sigmund A. Hollinger

Kerrigan Iron Works, Inc.
1033 Herman St., Nashville,Tenn. *G. E. Daniels*

Keystone Electric Manufacturing Co.
2228-36 E. Tioga St., Philadelphia 34, Pa.
Leonard M. Siegel

The Kirlin Company
3455 E. Jefferson Ave., Detroit 7, Mich.
Ivan Kirlin

Kopp Glass, Inc.
Swissvale, Pa. *F. C. Ashe*

The La Salle Lighting Products, Inc.
145 Seneca St., Buffalo 3, N. Y.
Richard C. Piper, Jr.

Leader Electric Manufacturing Corp.
3500 N. Kedzie St., Chicago 18, Ill. *Walter Glass*

The Leeds & Northrup Co.
4901 Stenton Ave., Philadelphia 44, Pa.
I. M. Stein

Libbey-Owens-Ford Glass Co., Plaskon Division
2112-24 Sylvan Ave., Toledo, Ohio
Dr. M. H. Bigelow

Light Control Company
3217 Casitas Ave., Los Angeles 26, Calif.
Stanley E. Lindahl

(Continued on page 19A)

Here's one way to measure the 7500-hour life of Westinghouse fluorescent lamps

It would indeed require a king-sized hour glass to fully measure the 7500-hour life of Westinghouse fluorescent lamps. A better and more practical way, however, would be an actual installation. For here you'd find an even more impressive record . . . 2¼ years in stores, over 3 years in offices and one-shift factories. They cost *no* more and there's no better value for your money.

YOU CAN BE SURE . . . IF IT'S Westinghouse

Lamp Division,
Westinghouse Electric Corp.
Bloomfield, N. J.

Send me more information on how I can save with Westinghouse fluorescent lamps.

NAME..... TITLE.....

COMPANY.....

STREET.....

CITY..... ZONE..... STATE.....

IE

Average Light Intensity Increased **9** Times

Litecontrol Fixtures Made the Difference!

JOB: Hackman's Department Store, Newport News, Virginia.

DISTRIBUTOR: Noland Company, Newport News.

FIXTURES: No. 5628 2 lamp slimline surface fixtures, using Holophane® No. 9100 lenses, and diffusing glass side panels. No. 5600-22 corner boxes, using Holophane No. 774 lenses.

ROOM FINISH: Walls, dusty rose; ceiling, light gray.

CEILING HEIGHT: 18 feet.

INTENSITY: 45 footcandles in service, average.

Modern in every other respect, this department store had one serious problem: low visibility, the average light intensity was 5 footcandles.

Expert technical counsel resulted in the installation of LITECONTROL Lighting Fixtures. In this case, No. 5628 Slimline Surface units.

Average light intensity today is 45 footcandles, 9 times as great as before.

This is but one of the many hundreds of cases where *standard* LITECONTROL Fixtures improve sales-vision, effectively and economically.

A LITECONTROL consultation can very often help do a better job of putting the right fixture in the right place for the right light. On your very next problem, call in your LITECONTROL man . . . and *see*.

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

(Continued from page 16A)

Lighting & Lamps
114 East 32d St., New York 16, N. Y.
James Krieger

Lighting Products, Inc.
2259 W. Park Ave., Highland Park, Ill.
D. E. Dunne

Lightolier Co.
11 East 36th St., New York 16, N. Y. *H. Stollnitz*

Line Material Co., Division of McGraw Electric Co.
800 North 8th St., Milwaukee 1, Wis. *M. C. Harsh*

Litecontrol Corp.
36 Pleasant St., Watertown 72, Mass.
Paul H. Lamson

Lithonia Lighting Products Co., Inc.
Lithonia, Georgia *Robert J. Freeman*

Louisiana Power & Light Co.
142 Delaronde St., Station "A," New Orleans, La.
C. L. Osterberger

Luminator, Inc.
120 N. Peoria St., Chicago 7, Ill.
Albert L. Arenberg

T. R. Lyda Manufacturers Rep.
4922 Washington Blvd., Indianapolis, Ind.
T. R. Lyda

Lynn Gas & Electric Co.
90 Exchange St., Lynn, Mass. *James A. Cool*

Macbeth Corp.
P.O. Box 950, Newburgh, N. Y. *Norman Macbeth*

Malden Electric Co.
157 Pleasant St., Malden, Mass. *Donald S. Bennett*

Markel Electric Products, Inc.
129-14d Seneca St., Buffalo 5, N. Y.
Morris L. Markel

La Cie Martineau Electrique Ltee.
24 rue du Roi, Quebec, Canada *Henri Martineau*

Metalcraft Products Co., Inc.
Masher & Lippincott Sts., Philadelphia 35, Pa.
Nathan Bloom

Metal Window Institute
Cheltenham, Pa. *George Hingston*

Metropolitan Edison Co.
412 Washington St., Reading, Pa.
T. O. McQuiston

Metropolitan Electrical Supply Co.
20 N. Jefferson St., Chicago 6, Ill. *H. J. Privat*

Midwest Chandelier Co.
15th & Gentry Sts., No.Kansas City 16, Mo.
Sidney Lefkovitz

The Miller Co.
Meriden, Conn. *G. W. Beals*

Mississippi Glass Co.
98 Angelica St., St. Louis 7, Mo. *Reed Muir*

Mississippi Power Co.
Gulfport, Miss. *R. M. Shearer*

Mississippi Power & Light Co.
Lampton Building, Jackson, Miss. *Les Taylor*

Mitchell Manufacturing Co.
2525 Clybourn Ave., Chicago 14, Ill.
Bernard Mitchell

Modern Light Company
7809 Maplewood Industrial Court,
Maplewood 17, Mo. *J. E. Baker*

Modern Light & Equip. Co.
3812 S. Wabash Ave., Chicago, Ill.
M. L. Offenberg

Moe-Bridges Corp.
1415 Illinois Ave., Sheboygan, Wis. *M. B. Deutsch*

Moe Light, Inc.
700 Oak St., Fort Atkinson, Wis. *Stanley Warner*

Montana-Dakota Utilities Co.
831 Second Ave. So., Minneapolis 2, Minn.
W. L. Hayes

Municipal Light and Power Dept.
City of Pasadena, California, 302 City Hall,
Pasadena 1, Calif. *E. L. Bettannier*

Mutual Sunset Lamp Mfg. Co., Inc.
540 Empire State Bldg., New York 1, N. Y.
Morris Thau

The Narragansett Electric Co.
49 Westminster St., Providence 1, R. I.
C. R. Broadhead

National Chemical & Manufacturing Co.
Luminall Paint Div.
3617 So. May St., Chicago 9, Ill.
John Marshall Ziv

National Lighting Products
4221 W. Harrison St., Chicago 24, Ill. *D. J. Epp*

Nelson-Tombacher Co.
81 Prospect St., Brooklyn, N. Y. *M. J. Tombacher*

New Bedford Gas & Edison Light Co.
693 Purchase St., New Bedford, Mass.
W. S. Fenstermacher

New Orleans Public Service, Inc.
317 Baronne St., New Orleans, La. *S. L. Drumm*

Niagara Mohawk Power Corp.
300 Erie Blvd. W., Syracuse 2, N. Y.
Leland D. McCormac

Northern Electric Co. Ltd.
1520 Notre Dame St., West, Montreal, Quebec
F. P. Labey

Northern Indiana Public Service Co.
5265 Hohman Ave., Hammond, Ind.
J. C. Sackman

Northern Light Company
2051 N. 19th St., Milwaukee, Wis. *Fred Cramer*

Northern States Power Co.
Minneapolis 2, Minn. *Carl T. Bremicker*

Ohio Edison Co. (Akron Div.)
Akron 8, Ohio *C. L. Dunn*

The Ohio Power Co.
301-315 Cleveland Ave., S. W., Canton 2, Ohio
C. B. Morin

The Ohio Public Service Co.
P.O. Box 6058, Cleveland 1, Ohio *C. L. Dunn*

Oklahoma Gas & Electric Co.
Box 1498, Oklahoma City 1, Okla. *E. W. Gray*

Omaha Public Power District
720 Electric Bldg., Omaha 2, Nebraska
E. E. Schwalm

Pacific Gas & Electric Co.
245 Market St., San Francisco 5, Calif. *O. R. Doerr*

Pacific Power & Light Co.
522 Public Service Bldg., Portland 4, Oregon
C. A. Root

Peerless Electric Ltd.
1090 Pratt Ave., Outremont, Quebec
L. A. Van Duzer

Pennsylvania Electric Co.
535 Vine St., Johnstown, Pa. *Frank R. Knowles*

Pennsylvania Power Co.
19 E. Washington St., New Castle, Pa.
P. G. Dingledy

Pennsylvania Power & Light Co.
901 Hamilton St., Allentown, Pa. *J. M. Stedman*

Pennsylvania Wire Glass Co.
1612 Market St., Philadelphia 3, Pa.
Dr. Frank W. Preston

The Perfeclite Company
1457 E. 40th St., Cleveland, Ohio
Joseph L. Jaffe, Jr.

Philadelphia Electric Co.
1000 Chestnut St., Philadelphia 5, Pa.
H. B. Bryans

Philadelphia Electrical & Mfg. Co.
1200-36 N. 31st St., Philadelphia 21, Pa.
R. A. Manwaring

Phoenix Glass Co.
Monaca, Pa. *D. G. Cameron*

Pierce Electric Co.
367 W. Adams St., Chicago 6, Ill. *John H. Pierce*

Pittsburgh Corning Corp.
307 Fourth Ave., Pittsburgh, Pa.
Robert W. McKinley

Pittsburgh Plate Glass Co.
Grant Bldg., Pittsburgh 19, Pa. *R. B. Tucker*

Pittsburgh Reflector Co.
403-411 Oliver Bldg., Pittsburgh 22, Pa.
H. C. Zinsmeister

Portland General Electric Co.
Electric Bldg., Portland 5, Ore. *T. W. Fitch*

The Potomac Edison Co.
55 E. Washington St., Hagerstown, Md.
S. S. Bradford

Powerlite Devices, Limited
1870 Davenport Road, Toronto 9, Ont.
M. B. Hastings

Public Service Co. of Colo.
900 Fifteenth St., Denver, Colo. *G. B. Buck*

Public Service Co. of Indiana, Inc.
110 N. Illinois St., Indianapolis 9, Ind.
G. O. Stewart

Public Service Co. of Northern Illinois
72 W. Adams St., Chicago 5, Ill. *G. K. Hardacre*

Public Service Co. of Oklahoma
Box 201, Tulsa 2, Okla. *C. N. Robinson*

Public Service Electric & Gas Co.
80 Park Place, Newark 2, N. J. *H. P. J. Steinmetz*

Puget Sound Power & Light Co.
860 Stuart Bldg., Seattle 11, Wash.
Frank McLaughlin

Quadrangle Mfg. Co.
32 So. Peoria St., Chicago 7, Ill.
Dwight E. Worrell

Quaker City Electric Mfg. Co.
2810 East Pacific St., Philadelphia, Pa.
Reuben Huberman

Quebec Hydro-Electric Commission
107 Craig St., West, Montreal, Que.
Paul E. Poitras

Quebec Power Co.
229 St. Joseph St., Quebec, Que.
Jean Saint-Jacques

Rambusch Decorating Co.
40 W. 13th St., New York 11, N. Y.
Edward Rambusch

Revere Electric Mfg. Co.
6009-17 N. Broadway, Chicago 40, Ill.
Van N. Marker

Revere Electric Supply Co.
757 West Jackson Blvd., Chicago, Ill.
Floyd Fernau

Rochester Gas & Electric Corp.
89 East Ave., Rochester 4, N. Y. *L. C. Twitchell*

Rockland Light & Power Co.
Nyack, N. Y. *D. S. Schaab*

Rohm and Haas Co.
222 W. Washington Sq., Philadelphia 5, Pa.
F. W. Tetzlaff

(Continued on page 20A)

Ruby-Philite Corp.
52-02 Queens Blvd., Long Island City 1, N. Y.
Louis Phillips

Rumsey Electric Co.
1007 Arch St., Philadelphia 7, Pa. *T. W. Lauer*

Ryall Electric Supply Co.
1160 Stout, Denver, Colo. *C. O. Ryall*

The Safety Car Heating & Lighting Co.
P.O. Box 904, New Haven 4, Conn. *J. J. Kennedy*

St. Joseph Ry., Light, Heat & Power Co.
520 Francis St., St. Joseph 2, Mo. *F. P. O'Connor*

Sandee Manufacturing Co.
5050 Foster Ave., Chicago, Ill. *Cortes N. Sprankle*

Sandel Manufacturing Co.
3618 So. Loomis Place, Chicago 9, Ill. *A. L. Sandel*

San Diego Gas & Electric Co.
P.O. Box 1831, San Diego 12, Calif.
A. E. Holloway

Savannah Electric & Power Co.
Savannah, Ga. *J. L. Davidson*

Schomer Electric Supply
164 S. Broadway, Aurora, Ill. *Daniel Schomer*

The Albert Sechrist Mfg. Co.
1717 Logan St., Denver 5, Colo. *K. L. Francis*

L. J. Segil Co.
2500 W. North Ave., Chicago, Ill.
Louis Rosenstein

Shawinigan Water and Power Co.
600 Dorchester St., W., Montreal, Que.
J. K. Wilson

The Sherwin-Williams Co.
101 Prospect Ave., N. W., Cleveland 1, Ohio
J. A. Meacham

The Sight Light Corp.
P.O. Drawer C, Deep River, Conn. *E. L. Canfield*

Silvray Lighting, Inc.
R.K.O. Bldg., Radio City, New York 20, N. Y.
J. M. Gilbert

Smithcraft Lighting Division
A. L. Smith Iron Company
217 Everett Avenue, Chelsea 50, Mass.
Hugh M. Nazor

Smoot-Holman Co.
321 No. Eucalyptus Ave., Inglewood, Calif.
L. A. Hobbs

Sola Electric Co.
4633 W. 16th St., Chicago 50, Ill. *L. C. Marshall*

Solar Light Mfg. Co.
1357 S. Jefferson St., Chicago 7, Ill. *A. Lazerson*

The Solex Co. Ltd.
280 Faillon St.,West, Montreal, Que.
Leon Beauchamp

Southern Calif. Edison Co., Ltd.
601 West 5th St., Los Angeles 53, Calif.
Roy E. Dahlin

Southern Canada Power Co., Ltd.
355 James St., West, Montreal, Que.
George R. Atchinson

Southern Colorado Power Co.
Box 75, Pueblo, Colo. *E. H. Pemberton*

Southern Indiana Gas & Elec. Co.
P.O. Box 569, Evansville 3, Ind. *C. K. Graham*

Southern Lighting Mfg. Co.
P.O. Box 2546, Orlando, Fla. *Max K. Aulich*

Southwestern Gas & Elec. Co.
Box 1106, Shreveport, La. *J. E. Elliott*

Southwestern Public Service Co.
Amarillo, Texas *J. E. Cunningham*

Stanley Electric Mfg. Co.
8001 Laycock St., Philadelphia 42, Pa.
Bernard S. Heller

Stober Manufacturing Co.
2700 Roosevelt Rd., Broadview, Maywood, Ill.
Robert J. Besal

Steiner Electric Co.
3500 Milwaukee Ave., Chicago 41, Ill.
George S. Steiner

Sterling Reflector & Mfg. Co.
3249 West Grand Ave., Chicago 51, Ill.
Anton Oberhuber

Stone Manufacturing Co.
489 Henry St., Elizabeth 4, N. J. *Burt Wadams*

Sunbeam Lighting Co.
777 E. 14th Place, Los Angeles 11, Calif.
Herbert L. Krieger

Sun-Lite Manufacturing Co.
2555 Bellevue Ave., Detroit 7, Mich. *Fred Binder*

Sun-Ray Fluorescent Co.
2025 South Michigan Ave., Chicago, Ill.
Jerome Gimbel

Sylvania Electric Products, Inc.
1740 Broadway, New York 19, N. Y. *D. P. Caverly*

Tampa Electric Co.
Cass & Tampa Sts., Tampa 1, Fla. *F. J. Gannon*

Frank C. Toal Co.
3222-24 E. Jefferson, Detroit 7, Mich.
Harold C. Smith

Texas Electric Service Co.
Electric Bldg., Fort Worth 1, Texas
R. E. Hendricks

Thompson Electric Co.
1101 Power Ave., N. E., Cleveland 14, Ohio
Thayer B. Farrington

Thompson-Wilson Company
737 Spring St., N. W., Atlanta, Ga.
Thomas A. Willis

Toledo Edison Co.
Edison Bldg., Toledo 4, Ohio *Charles A. Harrison*

Toronto Hydro-Electric System
14 Carlton St., Toronto 2, Ont. *A. W. J. Stewart*

Torstenson Glass Co.
3235 N. Sheffield Ave., Chicago 13, Ill.
Elmer L. Torstenson

Triangle Industries
600 W. Adams St., Chicago, Ill. *Leonard Cohen*

Tri-Part Mfg. Company
934 Plum St., Detroit 1, Mich. *Julius Reznik*

Tristate Electrical Supply Co., Inc.
38 S. Potomac St., Hagerstown, Md.
Robert A. Stott

Tru-Lite Ltd.
824 Notre Dame St., W., Montreal, Que.
Omer M. Trudel

Underwriters' Laboratories, Inc.
207 E. Ohio St., Chicago 11, Ill. *Ferd. Neumer*

Union Electric Co. of Missouri
12th & Locust Sts., St. Louis 1, Mo. *W. L. Berry*

Union Metal Mfg. Co.
Canton 5, Ohio *W. A. Porterfield*

Unistrut Corp.
4118 Monroe Ave., Wayne, Mich.
James W. Attwood

Unistrut Products Company
1013 West Washington Blvd., Chicago 7, Ill.
George W. Butler

The United Illuminating Co.
80 Temple St., New Haven 6, Conn. *E. B. Haskell*

United Manufacturing Co.
Div. United Advertising Corp.
190 Whalley Ave., New Haven, Conn.
William R. Harris

Utah Power & Light Co.
Box 899, Salt Lake City 10, Utah *W. A. Huchins*

Verd-A-Ray Corp.
615 Front St., Toledo 5, Ohio *O. S. Levi*

John C. Virden Co.
6009-6105 Longfellow Ave., Cleveland 5, Ohio
W. G. Sawyer

John C. Virden, Ltd.
35 Front St., East, Toronto, Ont.
P. G. Kirkpatrick

Virginia Electric & Power Co.
Richmond, Va. *J. G. Holtzclaw*

Voigt Co.
1649 No. Broad St., Philadelphia 22, Pa.
C. J. Frank

The F. W. Wakefield Brass Co.
Vermilion, Ohio *A. F. Wakefield*

Warren Electric Co.
P.O. Box 2594, Houston, Texas *J. R. Thompson*

The Washington Water Power Co.
P.O. Drawer 1445, Spokane 6, Wash.
Carl L. Hoffman

The Watson Standard Co.
225 Galveston Ave., Pittsburgh 12, Pa.
H. E. Striker

Welsbach Engineering and Management Corp.
1500 Walnut St., Philadelphia 2, Pa. *H. H. Adams*

Westinghouse Electric Corp.
1216 W. 58th St., Cleveland 1, Ohio (P.O. Box 5817) *W. F. White*

Westinghouse Electric Supply Co.
113 North May St., Chicago 7, Ill. *Henry Czech*

Westinghouse Lamp Div.
Bloomfield, N. J. *Samuel G. Hibben*

West Penn Power Co.
14 Wood St., Pittsburgh 30, Pa. *Harry Restofski*

Wheeler Reflector Co.
275 Congress St., Boston 10, Mass. *K. A. Sawin*

Wiedenback-Brown Co., Inc.
111 Eighth Ave., New York 11, N. Y.
W. C. Stockberger

R. & W. Wiley, Inc.
119 Dearborn St., Buffalo 7, N. Y.
Robert C. Graves

H. E. Williams Products Co.
108 S. Main St., Carthage, Mo. *F. B. Williams, Jr.*

Wilmot Castle Co.
1255 University Ave., Rochester 7, N. Y.
E. H. Greppin

J. A. Wilson Lighting & Display Ltd.
280 Lakeshore Rd., Toronto 14, Ont. *J. A. Wilson*

The Windsor Utilities Comm., Hydro Div.
149 Chatham St., W., Windsor, Ont. *W. A. Shaw*

The Wiremold Company
Hartford 10, Conn. *D. Hayes Murphy*

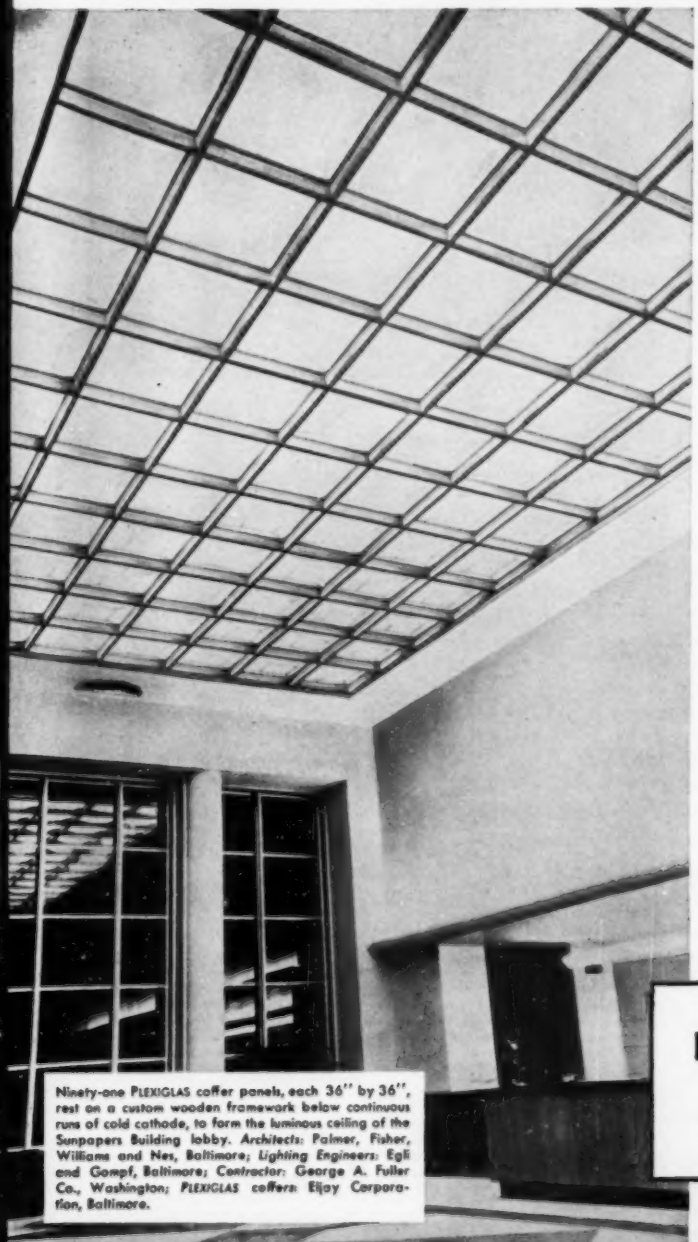
Wisconsin Electric Power Co.
Public Service Bldg., Milwaukee 1, Wis.
G. W. Van Derzee

Wisconsin Power & Light Co.
122 W. Washington Ave., Madison 1, Wis.
J. D. Howard

Wisconsin Public Service Corp.
Green Bay, Wis. *A. G. Burr*

Worcester County Electric Co.
11 Foster St., Worcester, Mass. *Fred E. Littlefield*

How a PLEXIGLAS Luminous Ceiling Solved a Design Problem



Ninety-one PLEXIGLAS coffer panels, each 36" by 36", rest on a custom wooden framework below continuous runs of cold cathode, to form the luminous ceiling of the Sunpapers Building lobby. *Architects:* Palmer, Fisher, Williams and Nes, Baltimore; *Lighting Engineers:* Egli and Gompf, Baltimore; *Contractor:* George A. Fuller Co., Washington; PLEXIGLAS coffers: Eljay Corporation, Baltimore.

Problem: To light this spacious, high-ceiling lobby of the new Sunpapers Building in Baltimore, and maintain its clean architectural design. Solution: A luminous ceiling of PLEXIGLAS acrylic plastic panels.

With PLEXIGLAS luminous ceilings, lighting becomes an architectural component, not a design afterthought. The white translucent diffusers — corrugated, flat, or formed into three-dimensional shapes—conceal lamps, ducts and pipes *completely*. Yet the output of the lighting source is utilized fully, due to high transmission efficiency. The luminous area overhead is the visible source of light—a lighting fixture as big as a room.

Other advantages: Complete, uniform diffusion; high illumination levels with low source brightness; control of brightness ratios; reduction of glare, shadows, and specular reflection to a minimum; the creation of a luminous environment. And the light weight and strength of PLEXIGLAS give freedom from breakage during installation and maintenance, and safety overhead in service.

Our new booklet—PLEXIGLAS LUMINOUS CEILINGS—outlines design considerations and presents case studies. Write for your copy today.

● A substantial volume of PLEXIGLAS production, now at record levels, is required for the defense mobilization program. The supply available for civilian applications is limited.

CHEMICALS FOR INDUSTRY

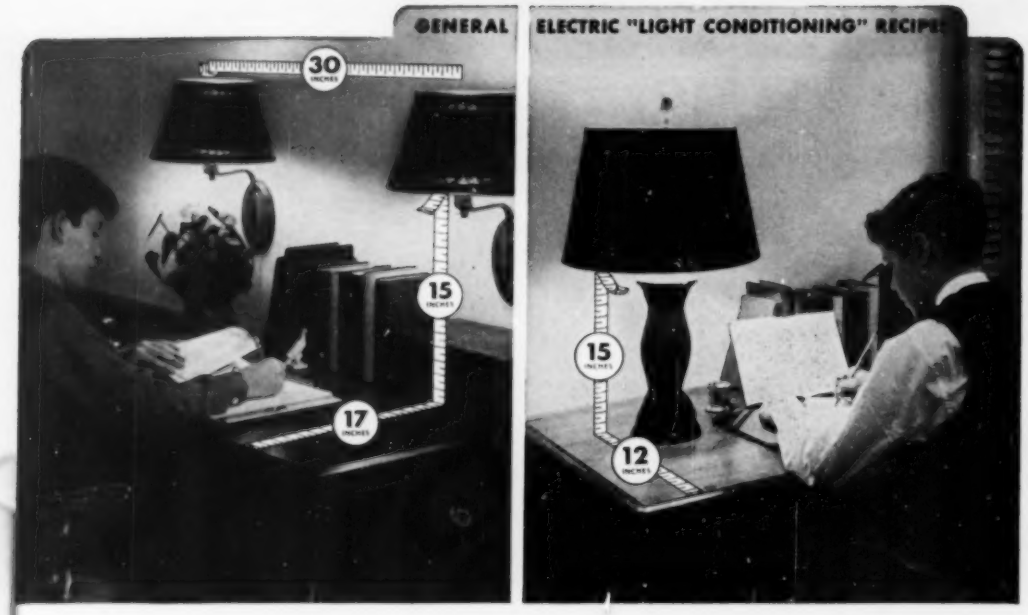
ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

PLEXIGLAS *is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.*

Canadian Distributor: Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.



Two ways to brighten a book...and a boy!

"THE way to improve Jimmy's marks, we'd always figured, was just to keep his nose to the grindstone. And try not to grumble when we had to place ours there, too—to help him find a state capital that kept getting lost or check a column of figures that wouldn't add.

"But then we made a great discovery: a boy doesn't study with his nose—he uses his *eyes!*

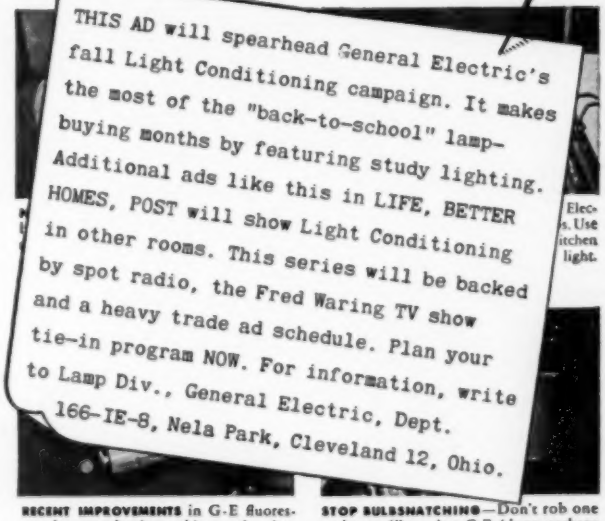
"When we discovered Light Conditioning we found we could not only brighten Jimmy's books, but Jimmy, too—by reducing eyestrain, fatigue and distraction."

Light Conditioning tells you in recipe form exactly what size and type of bulbs to use in your lamps and fixtures, and how to locate them to get the right light for every seeing task.

The recipe at left above calls for two pin-up lamps placed as shown by tape measures, each with a G-E 100-watt White "Q-coat" bulb. Recipe at right above recommends 50-100-150 watt 3-lite bulb (or, for some table lamps, 150 watt bulb or 150 watt White Indirect-lite bulb).

FREE! NEW LIGHT CONDITIONING RECIPE BOOKLET Shows 22 lighting recipes. Covers every room. Specifies bulb sizes, fixtures, measurements. Write Lamp Division, General Electric, Department 166-IE 8, Nela Park, Cleveland 12, Ohio.

THIS AD will spearhead General Electric's fall Light Conditioning campaign. It makes the most of the "back-to-school" lamp-buying months by featuring study lighting. Additional ads like this in LIFE, BETTER HOMES, POST will show Light Conditioning in other rooms. This series will be backed by spot radio, the Fred Waring TV show and a heavy trade ad schedule. Plan your tie-in program NOW. For information, write to Lamp Div., General Electric, Dept. 166-IE-8, Nela Park, Cleveland 12, Ohio.



Elec-
s. Use
itchen
light.

RECENT IMPROVEMENTS in G-E fluorescent lamps make them a bigger value than ever. More efficient, longer lasting, with better color and uniformity, less end-blackening. 25-watt fluorescent **$1.00** plus tax.

STOP BULBSNATCHING—Don't rob one socket to fill another. G-E 4-lamp package helps you keep spare bulbs on hand. Four 60-watt lamps (halls, closets) **56¢**. Four 100-watt (reading, general lighting) **64¢** plus tax.

You can put your confidence in—

GENERAL ELECTRIC

FIRST instant starting series sequence ballast
BEST instant starting series sequence ballast

Proven SOLA Sequenstart* BALLASTS by over 250,000 installed units

COOLER OPERATING†

VENTILATED CASE†

SELF-PROTECTING†
Temperature rise is automatically limited when either lamp is out of circuit.

LOWER OPERATING COST†
Less initial ballast cost, longer ballast life, lighter weight, more lumens per watt, less ballast maintenance.

SMALLER and LIGHTER†

MORE EFFICIENT†
Lower energy dissipation reduces wattage loss.

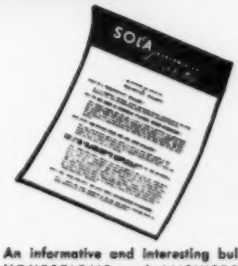
†COMPARED WITH AGAINST CONVENTIONAL LAG-LEAD BALLASTS

Made under one or more of the following patents: 2,143,745; 2,212,198; 2,346,621; 2,552,111; 2,489,245; and patents pending.

LESS HANDLING COST†
Considerably less material necessary reduces fixture weight, shipping charges and installation expense.

QUIETER†

It is a matter of record that the new engineering developments in ballast design and manufacture have originated with SOLA Electric Co. This fact is universally recognized by lighting engineers, fixture designers, architects and contractors. Recent discussions concerning the merit of the Sequenstart* versus the conventional Lag-Lead Ballast are reminiscent of the pre-heat versus instant-start controversy several years ago. The proof of the pudding is in the eating, and an ever increasing number of leading fluorescent fixture manufacturers, engineers and architects are using and specifying SOLA Sequenstart* Ballasts because of their outstanding advantages. Time has vindicated this choice.



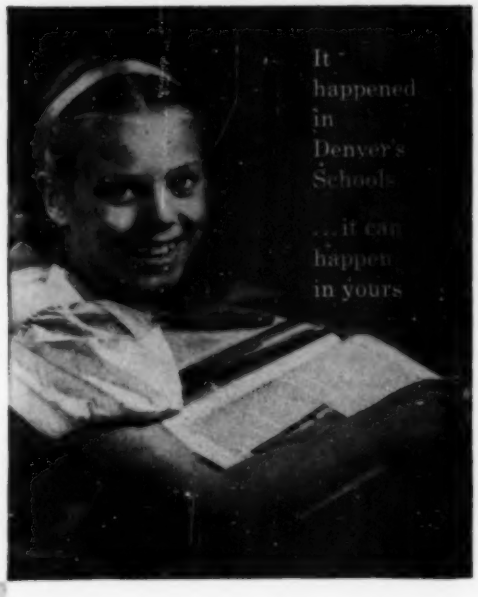
An informative and interesting bulletin "QUESTIONS and ANSWERS on SEQUENSTART* BALLASTS" is available. If you haven't already received a copy we will be happy to send it to you; write for Bulletin CFL-146.

SOLA Sequenstart* BALLASTS

Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Airport Lighting • Series Lighting • Luminous Tube Signs Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • SOLA ELECTRIC COMPANY, 4633 W. 16th Street, Chicago 50, Illinois

Q. Does Your School Have a Lighting Problem?

A. Day-Brite has the Answer!



If your school has a lighting problem, we feel certain you will find a solution in Day-Brite's two booklets—"It happened in Denver's Schools . . . it can happen in yours" and "Day-Brite lights the way . . . for students . . . across the U.S.A." —both offered to you without obligation.

Day-Brite has conducted extensive scientific research on classroom lighting and Day-Brite engineers have gained the "know-how" to make quality lighting fixtures . . . install the kind of light that students need. So, write today, let Day-Brite answer *your* questions on school lighting!

NOW, MORE THAN EVER

AMERICA MUST SEE WHAT IT'S DOING

IT'S EASY TO SEE WHEN IT'S

"DECIDEDLY BETTER"
DAY-BRITE
Lighting Fixtures

Day-Brite Lighting, Inc.
5432 Bulwer Avenue
St. Louis, Missouri

Please send me:

☐ "It happened in Denver's Schools...it can happen in yours."

☐ "Day-Brite lights the way...for students... across the U.S.A."

Name_____

Address_____

City_____ State_____

156

PUBLICATIONS *of the*
ILLUMINATING ENGINEERING SOCIETY

These publications summarize the studies and conclusions of technical committees of the Illuminating Engineering Society over a period of years. They contain the latest available information about many aspects of the art and science of illumination, and include details of application as well as lighting technique. Each publication listed here carries the authority and approval of the Society.

These Society publications are available in single copies for information and for lighting reference book shelves or in quantity for educational or other distribution. Each publication is numbered for ordering when using the coupon printed on the back of this page.

(1) I.E.S. LIGHTING HANDBOOK

One volume, 850 pages. A complete reference guide providing basic information on all phases of lighting. For architects, designers, engineers and others who plan, install and manufacture lighting systems and equipment. $7.50 per copy; $5 in lots of 10 or more.

I.E.S. Members who have not availed themselves of the privilege of one membership copy at $5 may still do so. Add 50c if for shipment abroad.

I.E.S. APPROVED LIGHTING PRACTICES

These booklets contain the latest official I.E.S. lighting recommendations; illustrated with charts, sketches and photographs.

(2) HOME LIGHTING Recommended Practice (1947)

(3) OFFICE LIGHTING Recommended Practice (1947)

(4) STREET AND HIGHWAY LIGHTING American Standard Practice (1947)

(5) LIGHTING PRACTICES FOR STORES AND OTHER MERCHANDISING AREAS (1948)

(6) SCHOOL LIGHTING American Standard Practice (1948)

(7) LIBRARY LIGHTING Recommended Practice (1950)

(8) DAYLIGHTING Recommended Practice (1950)

Booklets above available at 30 cents per copy or in quantity as follows: first 4 copies, 30c each; next 20, 25c each; all over 24 copies, 15c each.

(9) INDUSTRIAL LIGHTING American Recommended Practice (1948)

First 10 copies, 25c each; next 40, 20c each; all over 50 copies, 15c each.

LIGHTING IN INDUSTRY

Lighting recommendations based on recent studies (research, surveys of current practice, and experimental installations) of the I.E.S. Committee on Lighting Study Projects in Industry; completely illustrated. Contain analyses of seeing tasks; recommended quality and quantity of lighting; and suitable lighting methods and systems for both general and supplementary lighting.

(10) LIGHTING FOR WOOLEN AND WORSTED TEXTILE MILLS (1948)

Detailed treatment of lighting for opening and grading, carding, spinning, weaving, and perching. Much of data is also applicable to other types of textile mills.

(11) LIGHTING FOR MACHINING OF SMALL METAL PARTS (1949)

Revision of the 1939 report. Analysis of factors affecting visibility of convex scales, steel rules, scribed marks, center-punch marks, concave specular surfaces, plane and convex surfaces; general shop lighting; and supplementary lighting for various measuring instruments, bench work, machine tools, and inspection of polished surfaces.

(12) LIGHTING FOR FLOUR MILLS (1949)

Close-up photos of visual tasks and levels and quality of illumination for roll, sifter and purifier floors; packing areas; and product control stations.

(13) LIGHTING FOR CANNERIES (1950)

Recommendations based on committee study and research on general supplementary artificial lighting and daylighting for tasks common to all types of canneries; lighting for color grading and container inspection; and detailed analyses of seeing tasks and suggested lighting layouts for peach, apricot, tomato and olive canning. Also treated are light sources and equipment suitable for installation in canneries; glare and brightness ratios; sanitation and safety; measurement of light; and adequate electrical wiring.

(14) LIGHTING FOR BAKERIES (1950)

Committee study report on baking industry; complete with photos and drawings of typical floor arrangements and lighting layouts; paint color for visual environment; use of day lighting; lighting levels for various departments; maintenance. Also includes description of use of ultraviolet radiation.

Booklets (10) to (14) available at 50c each; quantity prices upon request.

(over)

M-8/51

ILLUMINATING ENGINEERING SOCIETY
1860 Broadway
New York 23, N. Y.

Date _____

Please send me, addressed as below, copies of I.E.S. Publications which I have indicated by number.
☐ My check (money order) is enclosed. ☐ Bill me.

Item No.

_____ copies _____
_____ copies _____
_____ copies _____
_____ copies _____
_____ copies _____

Name _____
Company _____
Street _____
City _____ Zone _____ State _____

Indicate publications wanted by number. Enter name and address. Clip out and mail.

COMMITTEE REPORTS

(15) CONTEMPORARY LIGHTING IN MODERN AND TRADITIONAL INTERIORS (1951)
64-page report combines recommended residence lighting with good decoration techniques. Report written in laymen's language and is completely illustrated. 130 large-scale photographs and drawings show interiors and sketches of construction details using light and color in different home surroundings, Colonial to Modern. Covers both installed luminaires and portables, with separate chapters for cove, recessed, window and wall lighting; ceiling fixtures and wall brackets; portable lamps; use of fluorescent tubes, etc. Available at $1 per copy; quantity prices upon request.

LIGHTING DATA SHEETS

Photographs, drawings and engineering data on actual installations. Sheets punched for binders, available on lighting for metalworking, textile, automobile and other industries; schools; stores; offices; drafting rooms; churches; auditoriums; banks; museums; residences; indoor and outdoor recreational areas; and street and highway lighting.

New Series XVI can be ordered now for immediate delivery of first eight sheets. Renew subscription today.

(16) SERIES XII and XIII—24 sheets each—$1 per series.

(17) SERIES XIV AND XV—24 sheets—$1.25 series.

(18) SERIES XVI—Subscription for 24 sheets—$1.25.
Delivered throughout year; first group of eight (8) sheets now available; balance in two mailings by January, 1952.

(19) SPECIAL DATA SHEET BINDER
New style, durable loose-leaf binder bound in blue fabrikoid and attractively stamped in gold. Single binder $1.50; in lots of 25 or more, $1.25.

LIGHTING COURSE MATERIAL

(20) EXPERIMENTS WITH LIGHT
Practical problems suitable for high school science classes. 25c each.

(21) LIGHTING FUNDAMENTALS
Lithograph outline for a one-semester introductory lighting course suitable for college students or adults. $1 each; 10 or more, 75c.

(22) LIGHTING DESIGN PROBLEMS COURSE
Lithograph outline and data sheets for a one-semester course to follow "Lighting Fundamentals." Sections on illumination design methods, brightness ratio calculations, light sources, color in illumination, fixture design evaluation, evaluating lighting installations in the field, bactericidal and infrared energy, and design of installations for office, store, school, industrial and floodlighting. $1.50 each; 10 or more, $1.25.

OTHER PUBLICATIONS

(23) TESTING PROCEDURES FOR ILLUMINATION CHARACTERISTICS (1948)
Five committee reports in one volume: guides to testing fluorescent lamps and luminaires, and street lighting luminaires. $1 per copy.

(24) STANDARD METHOD FOR MEASURING AND REPORTING ILLUMINATION FROM ARTIFICIAL SOURCES IN BUILDING INTERIORS
What to guard against in choosing instruments, where test stations are located and how to take readings. 10c each.

(25) FOOTCANDLE SURVEY (IS-10) FOR ARTIFICIAL ILLUMINATION IN INTERIORS
For use with (24) above, 2c each.

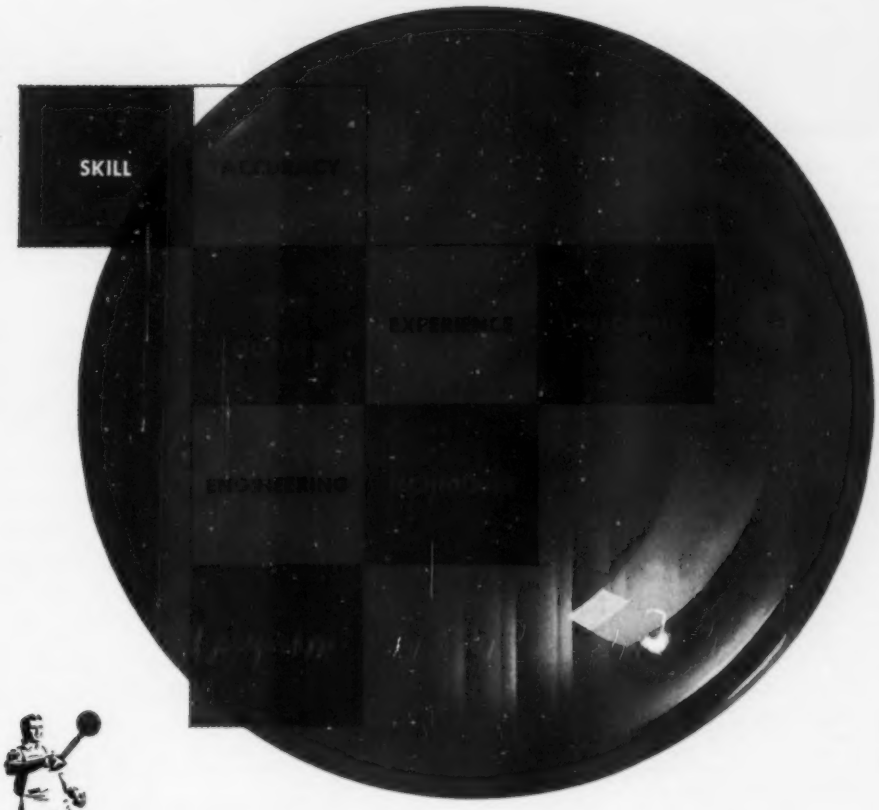
(26) LIGHTING EQUIPMENT ENGINEERING DATA SHEET
For equipment manufacturers and testing agencies for use as a guide in preparing forms for presentation of photometric and other pertinent data on lighting equipment. Also helpful to equipment purchasers as basis for required data. 10c each.

(27) ART GALLERY LIGHTING (1945)
Completely illustrated guide to lighting exhibits of sculpture and paintings. First 4 copies, 50c each; next 20, 25c each; all over 24 copies, 15c each.

(28) LIGHTING PRINCIPLES AND PRACTICE
A bibliography of selected papers dealing with lighting applications which appeared in the I.E.S. Transactions from 1920 to 1941. 50c each.

(29) GUIDE FOR LIGHTING DATA SHEETS AND LIGHTING PROBLEMS
Instructions for choosing installations and taking measurements, data and illustrations required for submission of I.E.S. Lighting Data Sheets; definition and guide for preparation of I.E.S. Lighting Problems; check sheets for recording data for school, office, store and industrial lighting installations and task view. 50c each.

(30) ILLUMINATING ENGINEERING
The Journal of the Illuminationg Engineer Society. This monthly magazine contains articles on all phases of lighting of interest to lighting engineers, architects, interior decorators and ophthalmologists. Subscription price, $10 per year, plus 50c for delivery abroad; single copies, $1.50 each.



Behind the KOPP LENS . . .

. . . . . *is your guarantee of satisfaction*

Skill and experience are combined in both the design and manufacture of Kopp lenses, to assure complete fulfillment of your specifications. Because Kopp specializes in lighting glassware, employing modern laboratory research and highly developed manufacturing skills, you can have full confidence that Kopp lenses will give you the results you want.

KOPP GLASS

KOPP GLASS, Inc.
SWISSVALE, PA.

NEW EQUIPMENT DATA

AVAILABLE WITH COUPON

New manufacturers' catalogs and bulletins listed below are available free to readers of ILLUMINATING ENGINEERING by mailing the coupon. Circle the numbers of those items which you want, drop in envelope or fasten securely to back of penny postcard addressed to Publications Office.

1 No. 18 Catalog, 40 pages, illustrates and describes 75 wiring devices and incandescent lighting fixtures. Gives full specifications on each; includes shipping and packaging data. John I. Paulding, Inc., New Bedford, Mass.

2 Catalog No. SB 51 presents various types of stage switchboard equipment including new electronic switchboards; describes details of operation and company's engineering services. Hub Electric Co., Chicago, Ill.

3 Louvered incandescent lighting systems are described in "Skylike" folder illustrating this development. Booklet describes system and basic reflector and louver assembly; gives photometric and brightness data; shows various applications. Silvray Lighting, Inc., New York, N. Y.

4 Channel strip is described in this company's "Tra-Bak" bulletin which gives specifications and dimensions and shows some sample installations. Great Northern Mfg. Co., Chicago, Ill.

5 Bulletin DR2 describes 2-lamp semi-direct slimline luminaires in this company's "Dreadnaught" series; furnishes photometric and testing laboratory data; includes mounting details and accessories. Metalcraft Products Co. Inc., Philadelphia, Pa.

6 "Lighting of Railroad Properties" is title of new 72-page book discussing the problem of general railroad lighting and in a number of specific railroad locations from stations through shops and yards. General Electric Co., Cleveland, Ohio.

7 Four-page folder describes "Dua-Lite" and "Glo-Ray" night light, incandescent units for use in hospitals and elsewhere for over-the-bed installation and for corridors and stair landings. Curtis Lighting Inc., Chicago, Ill.

8 Catalog No. 78 shows complete line of "Monotube" street lighting poles, giving design details, specifications and some accessories made by this company. Union Metal Mfg. Co., Canton, Ohio.

9 Folder AIA 35-P-5 describes company's line of window shades for natural light control, including benefits from their use; furnishes swatches of materials available. Luther O. Draper Shade Co., Spiceland, Ind.

10 Electrical fittings including solderless wire correctors, cable and conduit, and wiring devices are shown in this company's Catalog 1050, 12 pages. Gives complete specifications, dimensional data, application instructions. Buchanan Electrical Products Corp., Hillside, N. J.

11 Catalog L-117 covers line of lenses, prisms, reflectors, quartz optical parts, miscellaneous optical parts made by this company; gives details on each type such as focal length and diameter and offers suggestions for ordering special types. Bausch and Lomb Optical Co., Rochester, N. Y.

12 "Convaire" folder describes luminaire for 40-watt general line fluorescent lamps for industrial applications, including accessories; gives dimensional details and illumination performance tables. The Miller Co., Meriden, Conn.

13 Bulletin No. 601 has just been issued on "Anchorlite," a suspended underside and inside illuminator; explains uses in railroad freight car and truck trailer loading, auto repair and storeroom bin lighting. Pyle-National Co., Chicago, Ill.

14 "9300 Series" of surface attached fluorescent units is described in six-page bulletin which gives specifications and illumination data; suggests installation procedure. Holophane Co. Inc., New York, N. Y.

15 34-page spiral-bound book publishes complete information about luminous ceilings, their conception, principles and development, applications, suggested room decoration; and gives data on illumination, acoustics and air conditioning. F. W. Wakefield Brass Co., Vermilion, Ohio.

16 Circular B-30-A describes new plug-in automatic "on-off" illumination control designed for service with street and sign lighting, industrial installations, as well as for controlling lights on obstruction markers, airway beacons and air strips. Weston Electrical Instrument Corp., Newark, N. J.

17 New, completely enclosed line of dry-type, air-cooled transformers is described by the manufacturer in Bulletin AC-186. Folder gives catalog numbers and specifications, including telegraphic code, dimensions, weight, output, etc. Acme Electric Corp., Cuba, N. Y.

18 Bulletin No. 88 describes "Industri-Line" of slimline fluorescent fixtures for industrial applications. Light distribution curves, CU tables, maintenance factors, and installation details on five different industrial units and accessory fittings are shown. Wheeler Reflector Co., Boston, Mass.

19 Bulletin 2015 gives details of this company's Type 400 control unit for banked secondary transformer systems which according to the manufacturer offer several new advantages in flicker reduction and other features. Heinemann Electric Co., Trenton, N. J.

20 New "Dynalite" line of 82 job-rated industrial fluorescent units is described in catalog No. 438 by this company. Catalog gives complete specifications for all models, dimensional diagrams, CU tables, light curves. Mitchell Mfg. Co., Chicago, Ill.

21 Bulletin 2565 discusses lighting for plant protection and recommends various types of flood and searchlights for specific types of installation. Six sample layouts for industrial plants give complete installation information, recommend lighting levels. Crouse-Hinds Co., Syracuse, N. Y.

Offer good for two months

Circle numbers wanted. Enter name and address. Clip out and mail.

PUBLICATIONS OFFICE 8-51
ILLUMINATING ENGINEERING SOCIETY
1860 Broadway
New York 23, New York

Send me items circled below:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Name_____

Company_____

Street_____

City_____ Zone_____ State_____

(*Continued from page 11A*)

Roby, C. W. P., Fluorescent Service, Inc., Tampa, Fla.

GEORGIA SECTION

Associate Members:

Elrod, J. W., Georgia Power Co., Atlanta, Ga.

Glass, J. R., Jr., Georgia Power Co., Atlanta, Ga.

HAMILTON ONTARIO CHAPTER

Associate Member:

Bryce, Thomas, J. A. Wilson Lighting & Display Ltd., Toronto, Ont.

IOWA SECTION

Associate Member:

Johnson, H. W., Johnson Electric Co., Des Moines, Iowa.

MEXICO CHAPTER

Associate Member:

Martinez, G. A., Instalaciones Electricas Hubard, S. A., Mexico, D. F.

MILWAUKEE SECTION

Associate Members:

Buzan, Milton, Wisconsin Electric Power Co., Racine, Wis.

Byrnes, C. W., Green Bay Board of Education, Green Bay, Wis.

Casolari, Dante, Kimberly Clark Co., Neenah, Wis.

Leister, T. H., 2963 N. Cramer St., Milwaukee, Wis.

Wisniewski, B. R., City of Milwaukee, Milwaukee, Wis.

MONTREAL SECTION

Associate Member:

Comm, D., Comm Electric Co., Montreal, Que.

NEW ENGLAND SECTION

Associate Member:

Chamow, M. F., 25 Abbottsford Rd., Brookline, Mass.

NEW YORK SECTION

Member:

Hughes, D. A., Western Electric Co., Kearney, N. J.

Associate Members:

Bluford, D. B., L. J. Segil Co., Chicago, Ill.

McPartland, J. F., Jr., McGraw-Hill Publishing Co., New York, N. Y.

Student Member:

Paris, Joseph, Whitman School, Mt. Vernon, N. Y.

NORTHERN CALIFORNIA SECTION

Member:

Stratton, R. W., Jr., Kaiser Engineer's Inc., Oakland, Calif.

Associate Members:

Coppin, C. C., III, Kaiser Engineers Div. of Kaiser Industries, Oakland, Calif.

Goettsche, G. A., Westinghouse Electric Corp., San Francisco, Calif.

Haluk, William, Haluk Lighting Co., San Francisco, Calif.

Jacobsen, E. U., Westinghouse Electric Corp., San Francisco, Calif.

Kirby, J. J., Westinghouse Electric Corp, San Francisco, Calif.

Sabaroff, B. J., 1179 Market St., San Francisco, Calif.

Turner, J. O., Turner Co., San Francisco, Calif.

Walker, W. C., Smoot Holman Co., San Francisco, Calif.

Wilson, O. A., Kaiser Engineers, Oakland, Calif.

NORTHWESTERN OHIO CHAPTER

Associate Members:

Cohane, H. E., Verd-A-Ray Corp., Toledo, Ohio.

Metzger, R. S., Jr., The Toledo Edison Co., Toledo, Ohio.

White, J. B., Verd-A-Ray Corp., Toledo, Ohio.

OHIO VALLEY SECTION

Associate Members:

Burrall, H. C., Sylvania Electric Products, Inc., Dayton, Ohio.

Dittrich, C. J., General Electric Supply Corp., Cincinnati, Ohio.

Singletary, L. G., Progressive Lighting & Maintenance Co., Columbus, Ohio.

PHILADELPHIA SECTION

Associate Member:

Schaeffer, Philip, West Philadelphia Electric Supply Co., Philadelphia, Pa.

PITTSBURGH SECTION

Member:

Warner, N. C., Westinghouse Electric Corp., Pittsburgh, Pa.

Associate Member:

Turner, D. E., 634 Chestnut Ave., Du Bois, Pa.

PUGET SOUND SECTION

Associate Member:

Janecky, C. H., Puget Sound Naval Shipyard, Bremerton, Wash.

ST. LOUIS SECTION

Associate Member:

Huckshold, A. C., Union Electric Co., of Mo., St. Louis, Mo.

SOUTHERN CALIFORNIA SECTION

Member:

Bell, H. A., 1310 W. Portland, Phoenix, Ariz.

(*Continued on page 30A*)

not one, not two, but

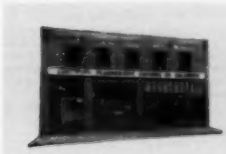
THREE PLANTS TO LIGHT THE WEST

What's behind the rapid sweep of All-Brite fluorescent fixtures across the West? Clean contemporary design... quality construction... highest lighting efficiency... Yes, all of these... but more. Above all, it is the solid endorsement of All-Brite luminaires by Western architects, engineers and builders that has placed All-Brite fixtures ahead of the rest in the West.

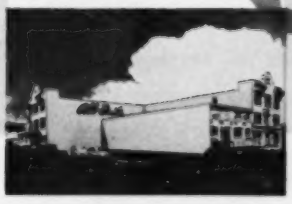
fluorescent fixtures of california

Sold only through leading distributors

write for complete catalog



portland: 1318 S. W. FIRST AVE.



san francisco: 3320 - 18th STREET

los angeles: 613 IMPERIAL STREET

All-Brite LIGHT OF THE WEST

originators of FLUORESCENT WESTERN CONTEMPORARY luminaires

FOR QUALITY

Specify

CHAMPION
Lamps

Champion
MEANS THE BEST!

known — since 1900 — for over 2000 different types and styles of Quality Lamps for general and special service needs.

Ask your industrial or electrical supplier, or write direct to

CHAMPION LAMP WORKS
Lynn, Massachusetts
A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

(Continued from page 29A)

Cage, H. D., 207 Goodrich Bldg., Phoenix, Ariz.
Freeman, H. E., 4304 S. Central Ave., Phoenix, Ariz.
Pike, L. L., 1622 N. Laurel Ave., Phoenix, Ariz.

Associate Members:
Benndorf, William, Wm. Benndorf Co., Phoenix, Ariz.
Buckley, T. L., Central Arizona Light & Power Co., Phoenix, Ariz.
Condon, L. M., Cepco Inc., Beverly Hills, Calif.
Gohring, J. F., J. E. Redmond Supply Co., Phoenix, Ariz.
Johnson, D. B., Central Arizona Light & Power Co., Phoenix, Ariz.
Lucas, M. O., Wm. Benndorf Co., Phoenix, Ariz.
Lucek, J. G., J. E. Redmond Supply Co., Phoenix, Ariz.
Racine, Karl, Falcon Engineering Co., Phoenix, Ariz.
Schurgin, S. B., Arizona Power & Light Co., Phoenix, Ariz.
Stevenson, R. E., J. E. Redmond Supply Co., Phoenix, Ariz.
Taylor, T. S., Grayco Products, Phoenix, Ariz.
Williamson, A. R., Central Arizona Light & Power Co., Phoenix, Ariz.

Student Members:
Fay, G. L., University of Southern Calif., Los Angeles, Calif.
Overpeck, W. F., University of Southern Calif., Los Angeles, Calif.
Spotts, V. J., University of Southern California, Los Angeles, Calif.

SOUTHWESTERN SECTION

Member:
Frandsen, D. J., Public Service Co. of Okla., Tulsa, Okla.

Associate Member:
Linebarger, Ray, Watt Plumbing Air Conditioning, Heating & Electric Co., Tulsa, Okla.

TENNESSEE VALLEY CHAPTER

Associate Member:
Cole, O. N., Southern College of Optometry, Memphis, Tenn.

Student Members:
Boardman, R. L., Southern College of Optometry, Memphis, Tenn.
Curry, A. L., Southern College of Optometry, Memphis, Tenn.
Glenn, H. J., Jr., Southern College of Optometry, Memphis, Tenn.
Gretzinger, B. I., Southern College of Optometry, Memphis, Tenn.
Hunt, J. G., Southern College of Optometry, Memphis, Tenn.
Kjome, A. M., Southern College of Optometry, Memphis, Tenn.
Wooton, C. D., Southern College of Optometry, Memphis, Tenn.

TORONTO SECTION

Associate Member:
Green, S. V., Q-R-S Fluorescent Ltg. Corp., Toronto, Ont.

ENGINEERING OPPORTUNITY

Large Northern Pacific Coast manufacturer has excellent opportunity for a mechanical engineer familiar with lighting fixtures. Write complete particulars to Box 144, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

POSITION WANTED AS SALES MANAGER

with firm manufacturing both commercial and industrial lighting. Have twenty years of experience in field of illumination and training of salesmen. Well known throughout the electrical trade. Address Box 143, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

INDEX TO ADVERTISERS
August 1951

Acme Electric Corp.	32A
Art Metal Co.	12A
Champion Lamp Works	30A
Corning Glass Works	13A
Day-Brite Lighting, Inc.	24A
Fluorescent Fixtures of California	29A
General Electric Co., Apparatus	10A
General Electric Co., Lamp	22A
Edwin F. Guth Co.	8A
Kopp Glass, Inc.	27A
Litecontrol Corp.	18A
Mitchell Manufacturing Co.	15A
Northern Light Co.	32A
Pittsburgh Reflector Co.	2A
R.L.M. Standards Institute	Inside Back Cover
Rohm & Haas Co.	21A
Sandee Manufacturing Co.	4A
Sola Electric Co.	23A
Sunbeam Lighting Co.	32A
Superior Electric Co.	31A
Sylvania Electric Products, Inc.	Back Cover
F. W. Wakefield Brass Co.	Inside Front Cover
Westinghouse Electric Corp., Lamps	17A
Westinghouse Electric Corp., Lighting	1A

Yours

A NEW LINE OF PACKAGED POWERSTAT LIGHT DIMMING EQUIPMENT

COMPACT PACKAGED ASSEMBLIES WITH COMPLETE FACILITIES FOR DIMMING, BRIGHTENING, BLENDING LIGHT

The popular economy line of **PACKAGED POWERSTAT** *light dimming equipment has been redesigned and a variety of new models offered. Assemblies of the 2000 watt series are now available in packages of 3, 4, 5 and 6 unit dimmers.*

Each packaged assembly is housed in an attractive smooth grey finished cabinet. Individual dimmers are operated by vertical hand levers with graduated drums. The levers can be interlocked for master control and when required a separate master handle can be provided. Each dimmer has its own on-off switch and circuit-breaker, card holder for circuit identifications and pilot light. These dimmers can be operated from a two wire — one phase, a three wire — one phase or a four wire — three phase a-c power source. Standard output connectors include a terminal board for solid connection, pin-jacks, parallel-blade receptacles and twist-lock receptacles. Send for Bulletin D651P to learn more about PACKAGED POWERSTAT light dimming equipment.

PACKAGED POWERSTAT DIMMERS IDEAL FOR SCHOOLS, CHURCHES, LODGES, HOTELS, RESTAURANTS, STORES, LOUNGES & CLUBS. WRITE FOR DESCRIPTIVE BULLETIN TODAY

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

5081 DEMERS AVE., BRISTOL, CONNECTICUT

☐ Please send me Bulletin D651P

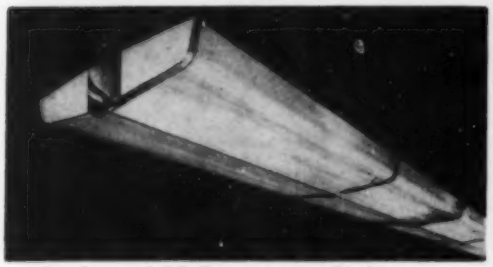
NAME_____

COMPANY_____

CO. ADDRESS_____

CITY_____ ZONE_____ STATE_____

MILWAUKEE ALBA HI-LITE



In Any of 10 Distinctive Styles . . .

the new Alba Hi-Lite will complement the architect's finest interiors . . . of banks, board rooms, executive offices, specialty shops, private clubs, restaurants, or institutions.

For beauty of simplicity . . . ***bent*** Alba-Lite—uncluttered by frameworks, cleared of half the usually used stems.

For life and punch . . . ***ribbed opal*** Alba-Lite, comfortable surface brightnesses, above average lumens per watt.

Surface or ***pendant, alone*** or ***in lines,*** 2- or 4-lamp, 2- 4- 6- or 8-foot lengths, for ***any*** lamp or ballast. ***Easy*** to lay out. ***Easy*** to hang. ***Easy*** to maintain.

Write for Engineering Bulletin B-121, General Specs B-122, Individual Specs B-123, Performance Data B-124, Applications B-125 et seq.

NORTHERN LIGHT
COMPANY
MILWAUKEE

QUIET MEANS QUALITY

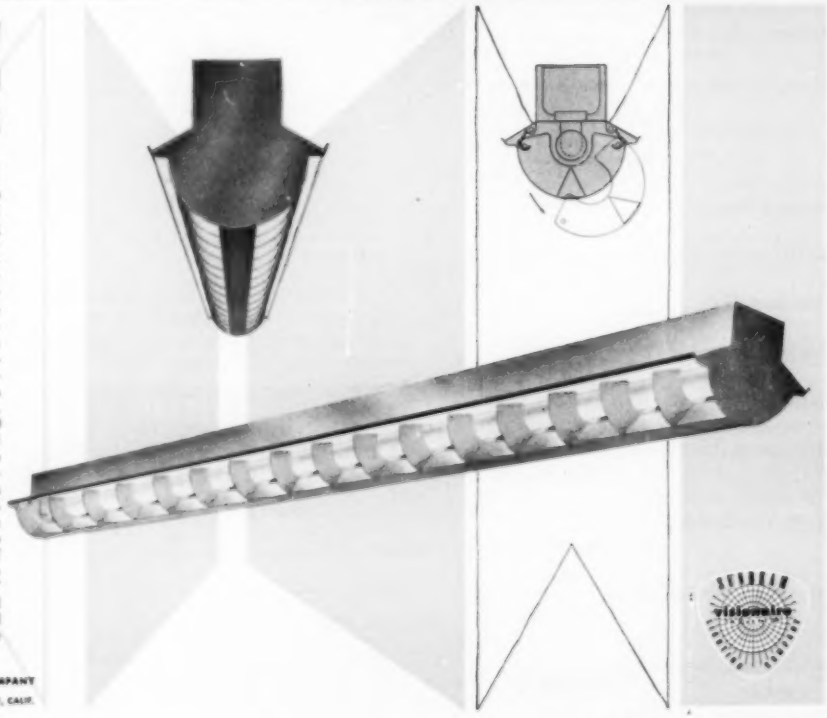
The core and coil assembly of an Acme Electric Ballast is made to such a high standard of excellence that normal magnetic hum is minimized and then further silenced thru impregnation. Assembly is sealed in the case, solidly imbedded in heat and cold resisting compound. Noise free operation is assured.

ACME ELECTRIC CORPORATION
298 WATER STREET **CUBA, N. Y.**

Acme ACME Electric

SUNBEAM'S NEW CORRIDOR AND STACK LIGHTS

Another advancement in functional lighting, this new Sunbeam visionaire (L330 series is especially designed to provide efficient lighting in narrow areas. This is the fixture to specify for lighting in corridors and over stairways where visibility for safety counts. This is the unit to install over library stacks, files, stockroom shelves, bins or similar applications where quick identification and readability is important. Simple to install, simple to maintain, the L330 series is available in all slimline lamp lengths with 200 or 430 milliamp ballasts. The sturdy louver with an inverted "V" provides complete shielding from below and is designed to reflect a large portion of the light outwards to walls or shelves. 6⅜" deep, 7" O.A. wide, 300° baked white durogloss enamel finish. Write for complete information.



SUNBEAM LIGHTING COMPANY
777 EAST 14TH PLACE • LOS ANGELES 21, CALIF.

Here are the Answers to the most frequently asked questions about the RLM LABEL

Q **What do the initials RLM stand for?**

A The "R" stands for Reflector, the "L" for Lighting equipment and the "M" for Manufacturers—*Reflector* and *Lighting Equipment Manufacturers.*

Q **What does the RLM Label stand for?**

A The label affixed to a lighting unit certifies that the reflector meets the minimum specification and performance standards, determined and established by the RLM Standards Institute.

Q **Who sponsors the RLM Standards Institute?**

A Incorporated as a non-profit organization, the Institute is sponsored by twenty manufacturers who voluntarily elect to manufacture industrial lighting equipment in accordance with RLM Standard Specifications.

Q **How are RLM Standard Specifications established?**

A The RLM Technical Committee, with the counsel of outstanding illuminating engineers, continuously reviews present specifications and suggests improvements and prepares new specifications. The Committee's recommendations then are reviewed by the Board of Trustees and finally submitted to the Institute Members for ratification. The adoption of new specifications requires approval by at least 80% of the membership.

Q **How does the RLM Label assure conformance to RLM Standards?**

A Representatives of the Electrical Testing Laboratories periodically visit the plants of all manufacturers participating in the RLM Specification-Certification Program. These ETL inspectors are authorized to take lighting units right off the assembly line or out of stock at random and make the required tests. They may also obtain test samples direct from distributors' stocks in order to check conformance to RLM minimum standards.

Q **Who are the Electrical Testing Laboratories?**

A Electrical Testing Laboratories, Inc., 2 East End Ave., New York 21, N. Y., is an independent testing organization which has conspicuously served industry for over 50 years. With this impartial and scientific organization rests the sole responsibility of determining whether or not an industrial lighting unit measures up to every individual quality standard that qualifies it to bear the RLM Label.

Q **What are the 4 Basic Tests made by Electrical Testing Laboratories?**

A (1) Quality of reflecting surface, (2) Reflection factor, (3) Shielding angle and reflector dimensions, and (4) Photometric test for light distribution and efficiency.

Q **In addition to design and construction features that meet certain minimum standards, what else does the RLM Label assure the buyer?**

A It provides the buyer with a warranty of uniform quality. In addition to the periodical inspections and tests made by the Electrical Testing Laboratories, the manufacturer warrants that every unit shipped by him meets the published specifications of the Institute.

Q **How many different types and sizes of RLM Units are there?**

A There are 18 basic types of RLM Units and 35 different sizes made by one or more of the 20 member-manufacturers. At present there is available a total of over 250 different makes and types of units which either bear the RLM Label or are on submittal for testing and certification at Electrical Testing Laboratories.

Q **How may I obtain free copies of all existing RLM Specifications and a check list of RLM-Member Manufacturers?**

A Send for the 44-page RLM Specifications Booklet and the new RLM Bulletin 1050. Write RLM Standards Institute, Suite 823, 326 W. Madison St., Chicago 6, Ill. Your copies will be mailed gladly without cost or obligation.

RLM STANDARDS INSTITUTE
INCORPORATED

The letters RLM stand for Reflector and Lighting Equipment Manufacturers

RS370

GET THIS SENSATIONAL NEW BOOK ON . . .

COLOR and LIGHTING

A valuable, non-technical treatise prepared by Sylvania in conjunction with leading color analysts

Here is one of the most complete and fascinating books on color and lighting ever printed.

Written in layman's language it explains inter-relation of light and color. Enables you to predict how colors will appear under different light sources. Covers such subjects as Reflection and Absorption . . . Complementary colors . . . Color temperature . . . How we see color.

Shows actual color values best suited to each of Sylvania's 7 different white-tone fluorescent tubes.

It explains color fatigue, color systems, color harmony and much other information of importance to architects, lighting men, and interior decorators.

You'll agree this book is really an outstanding value. But, the supply is limited. Don't miss this offer! Mail the coupon and 50¢ for your copy NOW!

Reg. price $1.00

SPECIAL OFFER 50¢

Sylvania Electric Products Inc.
Dept L-8108, 1740 Broadway,
New York 19, N. Y.

Enclosed please find 50¢ for my copy of "Color is How You Light It."

Name _____

Street _____

City _____ *Zone* ____ *State* _____

SYLVANIA

FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; RADIO TUBES; TELEVISION PICTURE TUBES, ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; PHOTOLAMPS; TELEVISION SETS